THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 42. Thursday, May 22, 1930. No. 718.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (4 lines).

Contents.

	PAGE
More Work for the Iron Founder	373
The Cost of Daylight	373
Pan-European Foundry Congress at Liége	374
Presentations to Derby Foundrymen	374
Iron and Steel Production in April	374
Random Shots	374
Institute of British Foundrymen	375
The Institution of Welding Engineers	375
Darlington Forge, Limited	375
Measuring Power in the Foundry	376
Tin- and Sheet-Mill Rolls: Their Treatment, etc.	377
The Constitution of the Alloys of Iron with Silicon	379
Templates for Assisting in the Rapid and Accurate Costing of Machine-Moulding Operations	381
Making a 12-ft. Wheel by a Floor Wheel-Moulding Machine	382
The Tin Situation	382
The Poumay Cupola	383
A Note on Nails	384
Catalogues Received	384
South Cave Sand Quarries Reorganised	385
Comparative Rail Transport Costs	386
Book Review	388
The Birmingham Metallurgical Society	388
Trade Talk	390
Personal	390
Obituary	390
Iron and Steel Markets	392
Company Meetings	392

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1929-30:
Wesley Lambert,
J. Stone & Company, Limited, Deptford, London, S.E.14.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham: F. K. Neath, 24, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, 26, Castlewood Road, Fulwood, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: W. Gilpin, "Sunnyside," Birch Grove, Rusholme, Manchester.
London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.
Newcastle-upon-Tyne: F. Sanderson, 15, Handyside Arcade, Newcastle-upon-Tyne.
East Midlands: H. Bunting, 82, Otter Street, Derby.
West Riding of Yorkshire Branch: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitchurch, Glam.
Middlesbrough: F. A. Harper, "The Briars," Bishopton Road, Stockton-on-Tees.

Foundry Trades Equipment and Supplies Association.

President: A. S. Beech, 13 to 15, Wilson Street, London, E.C.2.
Secretary: K. W. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. are at:—
24, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1883. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk *(Telephone 332).*

More Work for the Iron Founder.

In a recent review of progress in cast iron, an esteemed contemporary concluded with the following remarks:—"In spite of the increasing severity of modern engineering conditions and the constant development of special steel and non-ferrous metal alloys to meet them, the humbler iron casting will continue to occupy a useful and perhaps a growing place in industry. In our view, the aim of the ironfounder should be directed to increasing the confidence of the user in his products, thereby widening their sphere of application, by paying the strictest attention to such questions as quality, uniformity, soundness and finish." In this connection we feel it is important to point out that the result of developments proceeding at the present moment will almost certainly be to bring more work to the industry with which we are concerned. An interesting illustration of this is afforded by the possibility, referred to recently elsewhere in this journal, of the development of the heavy oil engine for road transport. The Diesel engine has been proved highly successful in the cases both of marine and of stationary land engines, and those who have visited recent exhibitions of engineering plant will have noticed one or two exhibits of modern lorries driven on heavy oil. Let us for a moment examine the economic factors that thus appear to be threatening the supremacy of the petrol engine. Obviously, the first is the price of petrol, including therein the petrol tax. Secondly, in spite of the extraordinary pitch of perfection that has been reached by the machinery for the distribution of petrol, there remains about it and about the mere fact of dependence on imported supplies a large element of uncertainty. Nevertheless, if the heavy-oil engine is to be a serious competitor in road transport it must be proved equally suitable and reliable. Supposing this to be the case, the position is that heavy oil costs about one-quarter of the price of petrol, in addition to which a heavy-oil engine will give more ton-miles per gallon than a petrol engine. Ton-miles per gallon must be considered as the ultimate cost of road transport, and on this reckoning there is a balance in favour of the heavy-oil engine to the extent of about 6 or 8 to 1 on the running cost. Some part of this advantage must be offset by the lower effective pressures of the Diesel engine and by its greater weight, but, even so, its advantages are very pronounced, especially if we add to them the greater safety of this type of fuel.

Great Britain cannot claim to be ahead of the world in this respect, since there are at least three other European countries well in the van. Nevertheless, these developments are still in the nature of pioneering, and our national success must depend largely on the ability of our industries to meet the new demands. In view of the large proportion of cast iron in the Diesel engine, this involves primarily on the foundry industry, and its success again depends largely on the amount of confidence that is placed in technical control, without which it is next door to impossible to meet modern requirements.

The Cost of Daylight.

In recent visits to British foundries we have noticed with a considerable amount of pleasure that much greater attention is being given to foundry lighting, both artificial and natural. When expressing our appreciation of the improved conditions, we are usually informed that "daylight costs nothing." That statement is definitely untrue, for a window-cleaning bill has to be met. The modern tendency in factory construction is to incorporate more and more glass; thus with the passing of time the cost of window cleaning—or inversely the cost of lower production, increased defective work and more accidents—becomes more onerous. This factor has only been appreciated to the full by a limited number of foundry organisations, and even these concerns have only partially solved the problem. A Belgian foundry, for instance, has built a gangway to deal with the side lights, and modified the overhead crane so that it can be utilised for the inside of the roof lights. A Derby foundry has laid mains on the roof so as to minimise "walking time" fetching buckets of water. Certain firms have installed a rail running under the guttering and around the whole of the walls, and from it there is suspended a cage carried on ball bearings. The window cleaner can thus work both vertically and horizontally over the whole of the outside walls. Even this does not solve the whole of the problem, as there is still the question of water supply, which, if considered when the building is designed, can easily be resolved. More attention will have to be paid to this subject in the future, and foundry executives would be wise if they armed themselves with an exact knowledge of existing costs, and extended to include their total if the ideal is to be attained, so that they may be in a position to prepare a statement showing what capital expenditure could usefully be made to ensure the ideal without becoming an extra burden on production. The ideal in this case is virtually a necessity.

XUM

Pan-European Foundry Congress at Liége.

PROVISIONAL PROGRAMME.

This Congress, which is to be held under the auspices of the International Congress of Mining, Metallurgy and Geology, will open on Monday, June 23, the week following the Middlesbrough Congress, and finish on Friday, June 27.

Monday, June 23.

10 a.m.—Opening of the Convention.
2 p.m.—Official visit of the Exhibition.
9 p.m.—Reception at the Provincial Palace by the Governor of the Province of Liége.

Tuesday, June 24.

9 a.m.—Session I: "Methods of Testing Cast Iron."
2 p.m.—Works visits. Choice of (*a*) the Cockerell Foundries, (*b*) the Ougrée-Marihaye Company, or (*c*) Tubes de la Meuse (pipe manufacturers).
9 p.m.—Reception by the Lord Mayor and civic authorities of the City of Liége.

Wednesday, June 25.

9 a.m.—Session II: "Special Cast Iron."
2 p.m.—Visit to the laboratory of the Fabrique Nationale d'Armes de Guerre.
5 p.m.—Meeting of the International Foundrymen's Committee.
8 p.m.—Banquet in the "Salle du Palais des Fêtes" at the Exhibition by kind permission of the Exhibition authorities.

Thursday, June 26.

9 a.m.—Session III: "Malleable Cast Iron."
2 p.m.—Session IV: "Sands, etc."
5 p.m.—Session V: Final addresses.
8 p.m.—Banquet of the Belgian Foundrymen's Technical Association.

Friday, June 27.

Excursion by motor-cars into the Belgian Ardennes, lunching at Spa.

Papers to be Presented.

Session I.—(1) "A Contribution to the Study of Methods of Testing Grey Iron," by H. Thyssen, Professor of Metallurgy in the University of Liége; (2) "The Application of the Shear Test in Controlling the Properties of Iron Castings," by a Committee of the Belgian Foundrymen's Association; (3) "A New Machine for Testing the Transverse, Shearing and Hardness Properties of Test-pieces Trepanned from Castings," by Prof. Thyssen and Mr. J. Bourdouxhe; (4) "Shear Testing by Punching: Its Application for Controlling Thin Sectional Castings," by Mr. A. Deleuse; (5) "Testing Cast Iron—with Special Reference to Recent Work done in Czecho-Slovakia," by Dr. F. Pisek, Rector of the University of Brno (Brunn); (6) "The Advantages and Disadvantages of the Various Melting Processes used in the Steel Foundry," by Mr. J. Deschamps (Official British Exchange Paper), and (7) "Electrolytic Iron," by Mr. Raoul Dupuis, of the Milan Steel Foundry.

Session II.—(1) "Some Problems in Chilled Castings," by Mr. Paul Ropsy (managing director of the S.A. Belge-Griffin-Antwerp); (2) "The Potentialities of Furnaces used in Grey-Iron Foundries," by Dr. Geilenkirchen (Official German Exchange Paper); (3) "On Some Physico-Chemical Modification of So-called Pearlitic Cast Irons," by Mr. A. Le Thomas (Official French Exchange Paper); (4) "Recent Developments in Nickel Cast Iron," by Mr. F. Renaud; (5) "Recent Progress in High-Tensile Cast Iron," by Mr. R. Lemoine; (6) "Some Factors Influencing the Chilling Properties of Cast Iron," by Dr. A. L. Norbury, Senior Metallurgist, B.C.I.R.A., and (7) "Desulphurisation of Iron and Steel," by Mr. Possenti, of Pessaro, Italy.

Session III.—(1) "Pulverised-fuel-fired Furnaces in German Malleable Iron Foundries," by Dr. R. Stolz; (2) "Recent Developments in the American Malleable Iron Foundry," by Mr. H. A. Schwartz; (3) "The Latest Development in the Malleable Iron Foundry," by Prof. Piwowarsky; (4) "The Evolution of the Malleable Iron Foundry in France," by Mr. Raymond Gailly; (5) "Some Notes on the Picture-Frame Defect in Malleable Castings," by Mr. M. Kagan and Mr. R. Deprez; (6) "The History of the Liége Malleable Foundry Industry," by Mr. R. Deprez; (7) "Progress Recorded in the Manufacture of Malleable," by Prof. Enrique Touceda.

Session IV.—(1) "Control of Moulding Sands," by Mr. H. W. Dietert (Official American Exchange Paper); (2) "Methods of Testing and Controlling Moulding Sand," by Mr. A. Deleuse; (3) "Practical Data on Mould Drying," by Mr. A. Debar; (4) "Notes on Casting Pulleys and Flywheels," by a Committee of the Belgian Association; (5) "The Use of Fluor Spar in the Cupola," by Mr. D. Deuvorst (Official Dutch Exchange Paper); (6) "The Production and Application of Light and Very Light Alloys in Italy," by Mr. A. W. Bonaretti, and (7) "Simplified Practice in the Metallography of Cast Iron," by Mr. F. Girardet.

For members of the Institute of British Foundrymen (who are cordially invited to participate), there will be no registration fee, but for others a small charge will be made. Those desiring to participate should communicate as soon as possible with Mr. T. Makemson, Saint John Street Chambers, Deansgate, Manchester.

Presentations to Derby Foundrymen.

The 33rd annual presentation of clocks to employees who have completed 21 years' service with the Ley's Malleable Castings Company, Limited, took place last week. Sir H. Gordon Ley, Bart., governing director, made the presentation. Eight employees were each presented with a mahogany clock, suitably inscribed, as a token of esteem and appreciation of 21 years' service.

Sir Gordon said he was pleased to attend this annual gathering. Altogether 367 clocks had been presented during the last 33 years, which was a splendid record. Owing to the uncertainty which had existed prior to the Budget of the Government's intention with regard to safeguarding and the McKenna duties, the trade of the country generally, and of their own particular industry, had been affected. Orders had fallen off somewhat which necessitated the works going on short time, but he was happy to say that now the McKenna duties had been retained, orders had improved to the extent that they were again on full time. He hoped circumstances would permit of this being continued.

Iron and Steel Production in April.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast at the end of April was 151, a net decrease of 6 since the beginning of the month. The production of pig-iron in April amounted to 619,600 tons, compared with 665,800 last March and 611,300 tons in April, 1929. The production included 194,300 tons of hematite, 242,200 tons of basic, 134,700 tons of foundry and 26,800 tons of forge iron. The April output of steel ingots and castings amounted to 696,100 tons, compared with 826,100 last March and 808,600 tons in April, 1929. Although part of the decline was due to the Easter holidays, the figures reflect a definite downward tendency.

Random Shots.

I have been reading about a wonderful new "Intensive Business Course," sponsored not only by a name distinguished in the annals of commercial education, but also by a most imposing Advisory Committee. It was as a matter of fact the sight of Sir Josiah Stamp's name on this committee that first caught my eye, and the names on the educational side are even more impressive than those on the business side. The idea is apparently to bridge the gap between the university and business that we are always hearing so much about, and to do it by the provision of a potted course in Applied Economics with facilities for the acquisition of shorthand, languages, etc. And a great point is made of the fact that the course aims at facilitating the absorption of educated men into business not only by giving them a knowledge of business principles, but by acquainting them with business conditions.

* * *

Now I have two comments to make. The first is that the really well-trained man has no need of such a course, for he can and does learn all the applied economics he wants in his spare time and from books, and he can and does pick up shorthand and commercial languages likewise in his spare time and at various classes already in existence. The second is that the real problem concerns business life, not in its commercial but in its industrial manifestations, and so far as I can see such a scheme as this offers no solution at all. It is not an uncommon error. A daily newspaper not long ago conducted a discussion on the paucity of well-trained men in *industry*, and proceeded to follow it up by offering scholarships to *commercial* colleges. The incongruity did not seem to strike those responsible, for the scholarship scheme was loudly proclaimed as a contribution to this specific question! I offer the criticism in the present instance with due diffidence, for I have not seen a detailed prospectus of the course, and for all I know its bite may be better than its bark. But it seems to me that the root of this matter of getting well-educated men into industry lies not in any lack of special knowledge but in the divorce that at present exists between the way of life and the habit of thought of the student on the one hand, and the industrialist on the other. And this divorce cannot be remedied by instruction in costing and marketing or a knowledge of the hours worked in a given business. There is, so far as I can see, no fitting preparation for industrial life save industry itself.

* * *

A recent reminiscence of that veteran of the iron and steel trade, Sir Hugh Bell, must have been "one in the eye" for the pessimists. He told how, about 1810, his father was advised by his own father—Sir Hugh's grandfather—to get out of the iron trade because it was finished! It has already taken 120 years over the finishing process, so I daresay it will last *our* lifetimes!

* * *

Marksman's Bulls'-Eyes.

Remarks over the garden fence may best be described as suburbanities.

Women are more often exacting than exact.

The Light that Failed must have been a Movie star who couldn't talk American.

Family life is the Englishman's excuse for club.

As the motorist said on a country road on market day: "This is ordeal by cattle."

Nothing gives a woman such a sense of superiority as having a man to put in the wrong.

Marksman.

Institute of British Foundrymen.

ANNUAL CONVENTION, MIDDLESBROUGH, JUNE 17 to 20, 1930.

As previously announced, the 27th Annual Convention of the Institute of British Foundrymen is to be held in Middlesbrough from June 17 to 20.

The local branch was formed only in 1926, and whilst numbers are small, enthusiasm is great. The Convention Committees have thrown themselves wholeheartedly into the work, and it is hoped that a very large number of members and ladies will attend. The railway companies have again granted special concessions to Convention delegates—single fare and one-third for the double journey (fraction of 3d. reckoned as 3d.) upon surrender at the time of booking the vouchers obtainable from the General Secretary. The tickets will be available from June 16 to 21, 1930.

Programme.

TUESDAY, JUNE 17.

6.0 p.m.—General Council meeting at the Constantine Technical College, Borough Road, Middlesbrough.

7.30 p.m.—Reception in the Constantine Technical College by Mr. and Mrs. William Shaw, 7.30 to 8.0 p.m. Inspection of the College, 8 to 9 p.m. Refreshments followed by B.B.C. artistes' musical programme, 9 to 11 p.m.

WEDNESDAY, JUNE 18.

9.15 a.m.—Conference commences at the Constantine College. Official welcome by His Worship the Mayor of Middlesbrough (Alderman Thos. J. Kedward).

9.45 a.m.—Annual general meeting of the Institute.

10.30 a.m.—Presidential address by Mr. F. P. Wilson, J.P.

11.0 a.m.—Presentation and discussion of Papers Nos. 1, 2 and 3.

12.15 p.m.—Conference adjourns.

12.30 p.m.—Omnibuses leave the Constantine College for lunch (kind invitation of the company), and works visit to (1) Dorman, Long & Company, Limited, South Bank.

12.30 p.m.—Luncheon in the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough (5 minutes' walk), by invitation of the Middlesbrough branch.

1.45 p.m.—Omnibuses leave the Cleveland Institute for the following works:—(2) Smith's Dock Company, Limited, South Bank; (3) Head, Wrightson & Company, Limited, Thornaby. Omnibuses will return from all three works to Middlesbrough, Stockton, Redcar and Saltburn, arriving in time for delegates to dress for the banquet.

7.15 p.m.—Annual banquet and dance (until 1 a.m.) in the Constitutional Hall, Stockton-on-Tees. Omnibuses will leave:—Station Square, Saltburn, 6.0 p.m.; Coatham and Swan Hotels, Redcar, 6.15 p.m.; Constantine College, Middlesbrough, 6.45 p.m., and return to these points after the dance.

THURSDAY, JUNE 19.

9.15 a.m.—Conference continued at the Constantine College. Presentation and discussion of Papers Nos. 4, 5, 6, 7, 8, 9 and 10 (two sessions).

12.15 p.m.—Conference adjourns.

12.30 p.m.—Luncheon in the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough (5 minutes' walk).

1.45 p.m.—Omnibuses leave the Cleveland Institute for the following:—(4) River trip to Tees-mouth (by kind invitation of the Tees Conservancy Commissioners); (5) Dorman, Long & Company, Limited, Port Clarence; (6) Richardsons, Westgarth & Company, Limited, Hartlepool; (7) Imperial Chemical Industries, Limited, Billingham.

8.30 p.m.—Visit to the Middlesbrough Opera House.

FRIDAY, JUNE 20.

9.30 a.m.—Motor-coach excursion over the Moors to Whitby, a distance of 32 miles, arriving about 11.30 a.m.

12.30 p.m.—Lunch at the Hotel Metropole, Whitby.

3.0 p.m.—Coaches leave by the coast road for Saltburn, where the delegates and ladies will be entertained to a garden party and tea at "Overdene," by kind invitation of Mr. and Mrs. William Shaw.

6.30 p.m.—Leave Saltburn (*via* Redcar) for Middlesbrough.

Ladies' Programme.

TUESDAY, JUNE 17.

7.30 p.m.—Reception at the Constantine College.

WEDNESDAY, JUNE 18.

11.0 a.m.—All ladies assemble for coffee at Dickson & Benson's Café, by kind invitation of the company.

11.30 a.m.—"Save the Countryside" Exhibition in the Middlesbrough Winter Gardens, promoted by the Society for the Preservation of Rural England.

12.30 p.m.—Luncheon in the Cleveland Institute.

2.0 p.m.—Drive into Cleveland, with tea at the Coatham Hotel, Redcar, by invitation of the Middlesbrough branch. Omnibuses leave the Cleveland Institute door.

7.15 p.m.—Annual banquet and dance at Stockton.

THURSDAY, JUNE 19.

9.30 a.m.—Visit to Messrs. Cerebos, Limited, Greatham-on-Tees, makers of "Bisto," Cerebos Salt, etc. Omnibuses leave Constantine College.

12.30 p.m.—Luncheon in the Cleveland Institute.

1.45 p.m.—River trip to Tees-mouth, by kind invitation of the Tees Conservancy Commissioners. Omnibuses leave the Institute door.

8.30 p.m.—Middlesbrough Opera House.

FRIDAY, JUNE 20.

9.30 a.m.—Motor-coach excursion Over-the-Moors to Whitby, returning by the coast road *via* Saltburn, Redcar, etc.

Papers to be Presented.

WEDNESDAY, JUNE 18. (Special sessions will be arranged.)

No. 1.—*American Exchange Paper.* "Developments in the use of Briquetted Borings for Cupola Melting," by F. J. Walls, Pontiac, Michigan, U.S.A.

No. 2.—"The Economic Utilisation of British Pig-iron Resources," by C. H. Ridsdale, F.I.C., F.C.S., and N. D. Ridsdale, F.C.S. (member).

No. 3.—"The Founding of Bronze Gear Blanks," by F. W. Rowe, B.Sc. (associate member).

THURSDAY, JUNE 19.

No. 4.—*French Exchange Paper.* "The Making of Iron Castings for Heating Apparatus, Stoves, and for General Building Purposes," by H. P. Magdelenat (Vice-President, Association Technique de Fonderie à Paris).

No. 5.—*Belgian Exchange Paper.* "The Preparation of Materials for the Converter when used for Steel Castings," by J. Léonard, Ingénieur A.I. Liége (President of the Asociation Technique de Fonderie de Belgique, and hon. member of the Institute of British Foundrymen).

No. 6.—"The Future of the Side Blown Converter in the Steel Foundry," by J. Deschamps (member).

No. 7.—"The Utilisation of Compressed Air in Steel Foundry Practice," by T. W. Barley.

No. 8.—"The Production of Large and Medium Sized High Class Iron Castings," by W. Scott.

No. 9.—"Reclamation of Oil Sand Cores," by Frank Hudson (member).

No. 10.—"The Factor of Personnel with regard to the Future of British Foundry Practice," by Douglas H. Ingall, D.Sc., F.I.C., F.Inst.P. (member), principal, Constantine Technical College, Middlesbrough.

Registration.

Members and ladies attending the Convention will receive, by post, prior to reaching Middlesbrough, a registration card bearing the member's registration number. This card should be exchanged upon arrival at the Convention office for an envelope containing tickets for the functions and visits indicated on the member's reply form. Members who desire to have their tickets, papers, etc., forwarded to them in advance, before the Convention, may obtain them by enclosing an additional 4d. per head when sending their remittance to the General Secretary.

Conference Office and Information Bureau.

The office will be open in the entrance hall of of the Constantine Technical College, for the issue of tickets, booklets, badges, and copies of Papers, as under:—Tuesday, June 17, 5 p.m. to 8 p.m.; Wednesday, June 18, 9 a.m. to 12 noon, and Thursday, June 19, 9 a.m. to 10 a.m.

Souvenir Booklet and Convention Badge.

A souvenir booklet giving full details of the programme, notes on the district, etc., will be presented to each member and lady attending the Convention. A badge will also be provided on arrival at Middlesbrough.

Correspondence.

Members may have their correspondence forwarded to them during the Convention, addressed:—c/o the Convention Office, Constantine Technical College, Middlesbrough.

The Institution of Welding Engineers.

The Institution of Welding Engineers is offering a prize of £10 10s. and the gold medal of the Institution for the best original paper offered by a *bona fide* operative welder, either oxy-acetylene or electric process. The competition is open to *bona fide* operative welders, whether members of the Institution or not.

The Institution will also have the pleasure of giving the prize-winner a permanent record of his success, and will arrange for the prize-winning Paper to be read before a meeting of the members of the Institution of Welding Engineers, either by the author or by proxy, as may be convenient.

The conditions attached to the competition are available on application to the Secretary of the Institution of Welding Engineers, 30, Red Lion Square, London, W.C.1.

Darlington Forge, Limited.

In the Chancery Division, last week, Mr. Justice Clauson had before him a petition by the English Steel Corporation, Limited, and the British Allied Investment Corporation, Limited, the object of which was to obtain the authority of the Court for the petitioners to give notice under Section 155 of the Companies Act, 1929, to those shareholders of the Darlington Forge, Limited, who had dissented or not assented to the scheme for the transfer of the shares of that company to the petitioning companies, that the petitioners desired to acquire their shares.

Mr. Gordon Browne (for petitioners) said that the issued capital of the Darlington Forge, Limited, was 510,000 preference shares and 510,007 ordinary shares, all fully paid. Petitioners had offered to pay 10s. for each preference and 4s. for each ordinary share. The holders of 503,809 preference and 489,296 ordinary shares had accepted the offer.

Mr. Justice Clauson said he considered the offer was one that ought to be accepted, and he made the order as asked.

Measuring Power in the Foundry.

By "Kilowatt."

In the design of a foundry the drive of any one machine may materially affect the economy of the whole plant. It is quite possible that some of the large air compressors may be equipped with efficient drives, but this efficiency may easily be lost in the wasteful operation of some of the smaller plant. It is in this connection that the electric drive offers a splendid opportunity for checking waste power, for by means of meters and other measuring devices a careful record can be taken of the operation of any individual machine, or group of machines, and by analysing such information steps can be taken to rectify errors and prevent waste.

These instruments are necessary to indicate, record and control the quality and quantity of the electrical energy used in the works. It must be remembered that as energy in the form of kilowatts costs money, any reduction in the kilowatt consumption of a plant is a direct saving. In order to effect such savings it is necessary that one should have a complete knowledge of the working condition of his plant, and this knowledge can only be obtained by the use of accurate testing and measuring instruments. It is admittedly impossible completely to eliminate loss, but it is possible greatly to diminish the existing losses and reduce them to an absolute minimum by the use of such instruments. A certain amount of loss often occurs in the distributive system which conveys the current from the switchboard to the various motors, and here the voltmeter, for example, can be used to advantage in detecting such losses.

Measuring Instruments and their Uses.

The selection of the proper instruments for use in connection with electrical plant in a foundry is a subject that would occupy too much space for an article of this nature, as also any attempt to describe the constructional features of such instruments. In order, however, that one may better understand their value, a brief note relating to those in general use may prove helpful to the power user.

Voltmeter.—This instrument is used to indicate the electrical pressure on any circuit, and as the volt is the unit of electrical pressure, the instrument is graduated in volts. As in the case of ammeters, due regard must be paid to its range, and it must be adapted to the system of supply.

Ammeter.—The rate of flow of electricity is called current, and is measured in amperes. The number of amperes of current in any circuit is ascertained by connecting a suitable ammeter thereto. It should be pointed out that the construction of the ammeter varies according as they are to be used with direct or alternating current and, therefore, it must not be expected that all types of d.c. ammeters will measure a.c. or *vice versa*. Moreover, it is essential that the range of the instrument is suitable, *i.e.*, an ammeter graduated for hundreds of amperes would be useless for measuring small currents.

Recording Ammeter.—In this instrument the scale is replaced by a chart moved at a fixed rate by clockwork. The pointer is fitted with a pen which travels over the chart. The combination of the motion of the pointer and the motion of the chart causes the pen to draw a curve which shows the variations in the rate of flow of a current through a circuit. Both time and current values are marked on the chart, so that it furnishes a permanent record.

Recording Voltmeter.—This similarly records, in volts, the variations in electrical pressure between two given points.

Wattmeter.—With a scale usually graduated in watts, this instrument is used to indicate the rate at which work is being done in an electrical circuit.

Recording Wattmeter.—An instrument used for recording the changes which take place from time to time in the rate at which the work is being done.

Watt-hour Meter.—This meter is used to determine the amount of electrical energy being expended. It measures and totals up the work done during each hour that the current flows, and as the energy represents watts consumed, it is calibrated in kilowatt-hours, *i.e.*, one B.O.T. unit.

Ampere-hour Meter.—For direct current work only. Where the voltage is practically constant and the energy expended will be proportional to the ampere-hours, and by multiplying this product by the voltage the actual watt-hours can be obtained.

Ohmmeter.—The function of this instrument is to register the resistance of an electrical circuit, and it takes its name from the ohm, which is the unit denoting electrical resistance.

Instrument Transformers.—Used on low circuits in order not to carry the large currents generated into the switchboard instruments. There are, of course, several special electrical instruments and meters, such as power factor meters, maximum demand meters, insulation testing instruments, and so one, which although perhaps not used to the same extent as the ones dealt with above, deserve their share of consideration, as their functions are equally valuable where the conditions call for their application.

Power Factor Meter.

The power factor meter is an instrument which at once reminds us of the growing importance of maintaining a high power factor on alternating current systems, since electricity supply tariffs are being framed more and more to charge increased or reduced rates depending on the power factor of the consumer's installation.

The Meaning of Power Factor.

In order to make it clear to the power user, who operates on alternating current, why it pays him to take steps to improve his power factor, it is desirable that he should first understand the exact meaning of the term. Briefly it expresses the proportion of the current taken from the mains, which is converted into mechanical power; in other words, the proportion of the current effectively used to the total supplied. A better explanation can perhaps be given by analogy.

If one imagines water in the place of electricity, one can picture more readily what is happening. The generating station pumps this water to the works in order that it may, under pressure, be used to drive machinery, thus giving up its energy in the form of mechanical power—it is this energy that the consumer really wishes to purchase, not the water. After the water has done its work it flows back to the power station to be pumped up again. Now this is just what happens with electricity. After it has given up its energy it returns along the mains to the generating station, but in the case of alternating current feeding a.c. motors, owing to the peculiar characteristics of this type of motor, they fail to make full use of the electric current flowing from the mains and utilise only a proportion, say 0.75. The remainder of the current (called idle or wattless current) not usefully employed is thrown back into the mains, and although the same amount of current that left the power house is returned, only 75 per cent. has been converted into actual energy, the other 25 per cent. returning unused.

The result is that the power authorities are compelled to provide larger plant and cables, in order to give the consumer the power he actually requires, than would be necessary if his power factor was high. Imagine a power station with plant generating 10,000 h.p. connected to a foundry whose power factor is 0.75, only 7,500 h.p. is actually utilised, as 25 per cent. of the power is idle current returned to the station unused. Nevertheless, in order to provide this 7,500 h.p., plant of 10,000 h.p. capacity has to be installed with consequent overhead expenses. On the other hand, a works using the same amount of power, but enjoying a high power factor, costs the supply company less for supply—hence tariffs based on costs of supply, which necessarily varies with the power factor.

How to Improve Power Factor.

Clearly, under these circumstances, it is in the interest of both consumer and supply station that the power factor should be as high as possible, and the question arises as to the best methods to be adopted in order to achieve this object. In the first place, it is necessary that the power factor of all the motors shall be high. Under the most favourable circumstances, the power factor of the induction motor (the motor used on alternating current systems) of ordinary sizes is between 0.8 and 0.9.

An a.c. induction motor gives its highest power factor when working at its maximum rated load, and this rapidly falls off when the motor is working on half load or below. This variation calls for the grouping of machines and the sizes of motors in such a manner that they all work as nearly as possible at their rated maximum capacity.

Taking the above precautions, the normal power factor of plant using induction motors may well be maintained, at as high a value as is possible, without the use of special apparatus. It is still possible, however, further to improve the power factor, and this is accomplished by the use of static condensers. There are other methods, such as the use of synchronous motors or phase advancers, but these entail the use of running machinery of some sort, and, therefore, increase maintenance costs; also, they are somewhat costly to instal. The outstanding feature of the static condenser is that it is a motionless piece of apparatus requiring no attention, and it does not require any special foundations.

Reports and Dividends.

Thos. Firth & Sons, Limited.—Profit for 1929, £126,090; dividend of 6½ per cent. on the ordinary shares; carried forward, £119,081.

Siemens Brothers & Company, Limited.—Final dividend of 5 per cent. on the ordinary shares, making 7½ per cent. for the year.

Tweedales & Smalley (1920), Limited.—Profit, £55,631; brought in, £87,308; final dividend of 2½ per cent., making 10 per cent. for the year; carried forward, £97,939.

Brush Electrical Engineering Company, Limited.—Net profit, £58,988; to reserve, £5,413; dividend (10 per cent.), £48,743; interest on prior lien participating second debenture stock, £2,044; to surplus account for apportionment between stockholders and co-partners, £2,787.

Applications for Trade Marks.

The following list of applications to register trade marks is taken from the "Trade Marks Journal":

"Gouldite."—Alloys of iron or steel. Goulds Foundries, Limited, Vulcan Foundry, East Moors Road, Cardiff.

"Silal."—Metals. The British Cast Iron Research Association, 24, St. Paul's Square, Birmingham.

"Gargantua."—Pumps. Hathorn, Davey & Company, Limited, Sun Foundry, Dewsbury Road, Leeds.

Three stirrups (device), with the words "The Three Stirrups."—Metals. A. Sauerland & Tupper, 17, Newhall Hill, Birmingham.

"Coploy."—Metallic alloys. Walter Stephen Lloyd-Willey, 347, Monega Road, Manor Park, London, E.12.

Tin- and Sheet-Mill Rolls: Their Treatment, Performance and Premature Failure in Service.*

By Eric R. Mort, B.Sc. (Griffithstown, Mon).

(*For references, see page* 388.)

Treatment of Rolls.

The sheet plant to which the data in this Paper relate comprises sixteen hot-mills of the single-stand type—that is, there are no roughing stands, all bars being broken down and finished off on one pair of rolls. Gauges of sheets rolled range from 6 B.G. to 31 B.G. (0.198 in. to 0.011 in.) inclusive, in widths up to 50 in. and lengths up to 144 in. On twelve mills, the roll-body diameter is 32 in. and 28 in. on the remaining four mills. Body lengths range from 38 in. to 56 in. in conformity with the widths of sheets in demand. For the period covered by most of the data (two years) plant operations approached 100 per cent. of capacity.

Rolls for use in tin- and sheet-mills are almost invariably made of cast iron, bearing a chilled skin approximately ¾ in. deep. At the present time, probably all rolls in use are cast solid, but about 1870-80 hollow rolls were tested at the Landore Tinplate Works, Swansea. They were made to the design of John Williams, of the neighbouring Millbrook Foundry, but, owing to the discouraging results obtained in regard to breakages, the experiments were not persevered with. Williams' roll, 19 in. in dia., was a simple chilled casting with a hole, about 1¼ in.

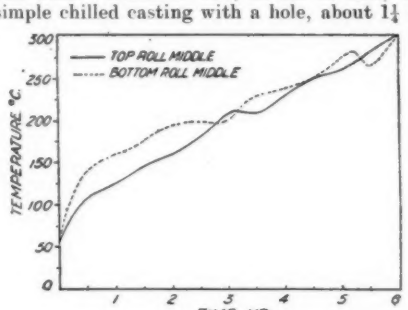


FIG. 1.—HEATING CURVE OF A ROLL.

in dia., cored out through the centre and parallel with the axis.

The idea of a hollow roll appears then to have been abandoned until it was revived by Thwaite[1] in 1892. Thwaite's design differed from Williams' in that he proposed to cast his roll in two distinctive parts:—(1) A core which would include the necks and wobblers and (2) the outer chilled casing for the body. His object in making the roll hollow was to permit the passage of water or oil for cooling purposes and to maintain the roll, as he states, "in a comparatively uniform thermic condition."

The question of analysis is treated in detail by Allison,[2] who says that "(*a*) Silicon is the dominating factor in determining the depth of chill; (*b*) manganese content in excess of 0.36 per cent. has the effect of reducing chill depth; (*c*) with moderately low sulphur and phosphorus contents, and manganese less than 0.36 per cent., the depth of chill is inversely proportional to the silicon contents; (*d*) the total carbon should not exceed 3.30 per cent. for a satisfactory length of service; (*e*) the sulphur contents should not be too high."

Compositions should vary within narrow limits; in practice, however, a considerable diversity is found. An average analysis would be as follows, but it is known that a number of makers do not aim for this:—T.C. 3.00, Si 0.73, Mn 0.40, S 0.11, P 0.47 per cent.

Of late years, certain roll-makers have introduced a small percentage of molybdenum, the addition being made to the metal as it flows from the melting furnace to the ladle.

The degree of surface hardness will range from 52 to 56 on the scleroscope scale, but usually a variation in both hardness and analysis will be found in different parts of the roll-face.

In a section through the roll there is seen the chilled outer skin, then an intermediate area known as the mottle, and, finally, the grey-iron core. The wedding of the chill to the core, resulting in the mottle, should have a well-knit appearance, showing the gradual merging of the grey iron into the chill; this gradual merge is important, because the coefficient of expansion of the chilled portion is approximately double that of the grey-iron core.

After casting and removal of gits, etc., the rolls are delivered from the foundries to the mills in either the rough—that is, as cast—neck-turned or finished-turned condition. If received in the "rough," all dressing of body and necks is executed on the rolling-mill lathes and/or grinder; this is preferable, inasmuch as a better conception of the roll's characteristics is then obtained by the mill supervisors.

A complete record to cover the roll in all its aspects should be made at this stage, including dimensions of body and necks, radii of fillets,

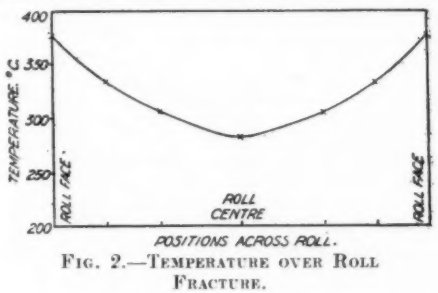


FIG. 2.—TEMPERATURE OVER ROLL FRACTURE.

depth and hardness of chill, straight-edge "cross," whether wobblers are to template, etc.

In turning the necks, the importance of concentricity need hardly be stressed; it is essential that both necks and body rotate about the same axis. The radius of the fillets also calls for consideration; this is governed by the relative diameters of the body and necks, the objective being to strike a fair balance between the strength of the body-neck junction and that of the brass lugs for resisting thrust. The ratio of sectional area of the neck to that of the body should approximate 60 per cent. Wobblers machined to close dimensions have a decided advantage over those sent straight from the mould.

Regarding the contours to which the bodies are dressed, this was recently discussed in detail by Mort,[3] who states that "the degree of concavity is determined by the following factors:—(1) Character of chill; (2) roll dimensions; (3) size and gauge of sheets to be rolled; (4) working temperature; (5) method of contour control, if any; and (6) mill production."

Considering the above factors very briefly:—(1) Generally speaking, harder rolls expand more than mild ones; (2) as the body length increases, the concavity decreases, the converse being the case with increase of diameters; (3) as pack lengths extend, so should the concavity. As pack widths are raised, the concavity is diminished. The lighter the gauge, the less the concavity required; (4), (5) and (6) are dealt with elsewhere in this section.

The dressed roll is now ready for commission, and it may be used as either a top or bottom roll, in either a leading or a trailing mill. If used as a bottom roll in a leading mill, then torsional as well as compressive strains have to be sustained; in the case of top rolls, compressive strains only are borne. Efficient millwrighting is all important, correct alignment and levels being essential to the smooth working of the several mills composing a train. This is an aspect ably treated by Caswell.[4]

It is customary at most plants, when placing rolls in commission for the first time, to put the bottom or stamped end of bottom rolls on the side nearest to the prime mover, reversing this order in the case of the top rolls. This procedure should be altered only when rolls are transferred from one side of a main drive to the opposite, so that the direction of rotation may remain unchanged during the life of the roll.

The next step in the history of the roll is the first warming-up. Whether a roll should be annealed or not, soon after casting, is a much-debated point, and little data would appear to have been published on this subject. Assuming that no previous heat-treatment has been applied, great care should be exercised in bringing the roll up to the working temperature for the first time; it should be done gradually and without subjecting the roll to undue strains, in order that all stresses remaining in the casting may be removed safely. Melaney[5] states that "All chilled rolls, due to the manner in which they must be cast, that is, by very rapid cooling of the outside surface while the centre of the roll is still molten, embody inherently a certain amount of strain, which later on is gradually eliminated, due to the annealing caused by the gradual heating up of the roll in the rolling of sheets and its continually remaining at this heat during the first week's work. After the roll has passed through this first annealing period its susceptibility to breakage is very much reduced. The statement can be safely made that the majority of rolls that finally break in service later on, have received on their first warming-up

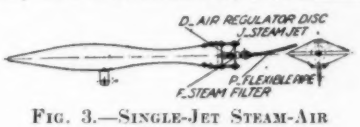


FIG. 3.—SINGLE-JET STEAM-AIR BLOWER.

the conditions that caused them to break, perhaps weeks afterward. At least 90 per cent. of all sheet- and tin-rolls broken are due to conditions arising from warming them up too rapidly at some time or other in their existence."

One of two methods of heating may be adopted: First, by heat of compression and conduction from rolling hot packs, and, secondly, by electricity, steam, oil, or gas flame. Perhaps one of the earliest recorded references to the preheating of rolls occurs in Thwaite's Paper,[1] wherein gas was suggested as the medium, but the author has no knowledge of any practical tests of this method of preheating having been made at about that date (1892).

In raising the roll temperature by the first method, the procedure is to commence with narrow orders, preferably of the heavier gauges, and thus impart heat to the middle of the rolls so as to remove the concavity. As soon as a straight line of contact between the roll faces is established—this occurs when the bodies have attained the correct working temperature—the maximum width of sheets for which the rolls have been dressed may be rolled. The time taken to raise the roll temperature to the required limit depends mainly on the roll dimensions and the rate of working. This method is unsatisfactory in that the quality of the sheets rolled during the warming-up period is usually poor, and also there is not at all times a demand for this class of material, hence the development of other methods of preheating. One of the earlier forms is described by Melaney,[5] but although heating by hot water has its advan-

* A Paper read before the Spring Meeting of the Iron and Steel Institute.

tages, the low maximum temperature attained caused its supercession by other means. In the United States, twenty-five to thirty years ago, natural gas of about 1,000 B.T.U. per cub. ft. was tried, but it was found that the flame produced by this heating agent was so intense that the chilled skin was heated so rapidly that disruption resulted.

According to Fox,[6] the electrical heating of rolls was first developed at the Inland Steel Company's plant near Chicago, in 1922. The heater used was of the resistance type, and since that time this type of heater has gained wide favour at tin- and sheet-mills in the United States. There are now very few mills in America that are not preheated at the beginning of each working week. A later development is an induction type of electric heater, the invention of K. Younghusband.[7]

The capital outlay involved in the installation of electric heaters, and the high operating costs where electrical current is comparatively dear, caused mill operatives in Great Britain to seek a cheaper method, with the result that fuel oil is now making considerable headway in sheet-mills in this country. The capital outlay is a fraction of that required for electrical installations, and operating costs are such that oil has a decided advantage over electricity if price of current exceeds, say, 0.25d. per unit. As far as the author is aware, nothing has been published concerning the heating of rolls by fuel oil, and a brief description of the equipment and methods in use at the plant with which he is connected may be of interest.

A centrally-situated storage tank, with a capacity of about 10 tons, is placed at an elevation of about 15 ft. Running parallel to the roll train, under the mill standing, is the service line from the storage tank; it is connected by short branches to points where suitable connections are made to the burners. After careful consideration and extensive tests, a burner in which steam was used for atomisation was selected. Preference was given to steam as an atomising agent for the following reasons: First, a steam-line connection to the mills, for roll-cooling purposes, was already in existence; and, secondly, the installation of an air-compressor motor for driving, and the necessary air-pipes, was deemed an uneconomic proposition, because the period of operation would not exceed 8 hrs. per week.

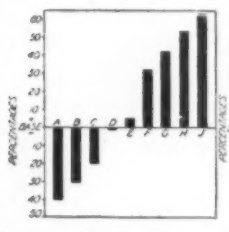


Fig. 4.—Comparative Roll Costs.

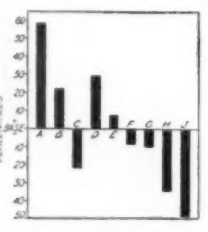


Fig. 5.—Comparative Roll Performances.

During the time of heating, the rolls are enveloped by sheet-steel hoods—surmounted by a short chimney—which assist materially in conserving the heat absorbed. Fig. 1 represents a typical heating curve for a 44-in. × 32-in. mill. A light grade of fuel oil was used having the following properties: Specific gravity 0.91, viscosity 70 sec. Redwood at 100 deg. Fah., and calorific value 19,730 B.T.U. per lb. Heating was commenced at midnight, and continued for 6 hrs.; the oil consumption was 218 lbs.—that is, about 36½ lbs. per hr. During this period the peripheral speed of the rolls was about 7 ft. per min., and the only delay was of 19 min. from 5.10 a.m. for coupling up the train; on the resumption of heating, the rolls were revolved at rolling speed. The average temperature rise of various parts of the rolls was as follows:—

Bodies	Middle ..	245 deg. C.	Average, 215 deg. C.
	Ends ..	184 deg. C.	
Necks ..	..	65 deg. C.	Average, 57.5 deg. C.
Wobblers ..	..	50 deg. C.	

The heat content of cast iron at 215 deg. C. is 48 B.T.U., and at 57.5 deg. C., 13.5 B.T.U. per lb. Given the weight of the roll bodies at 18,650 lbs., and the necks and wobblers as 14,100 lbs., the calculation of the heat efficiency is a simple matter:—

$$\text{Efficiency} = \frac{(18{,}650 \times 48 + 14{,}100 \times 13.5) \times 100}{218 \times 19{,}730} = 25.23 \text{ per cent.}$$

The cost was 0.348d. per lb. × 218 = 6s. 4d., and the rate of heat input per hr. per ton of roll was 12,373 B.T.U.

When raising rolls to the desired working temperature by rolling or by preheating, and also when this temperature is attained, the importance of correct drafting is pre-eminent. The treatment of "draft" in detail would necessitate more space than can be allotted in this Paper, but it may be mentioned that in no circumstance should the draft exceed 25 per cent.; sometimes it should be well below this figure.

It is also advantageous that the screw-pins be so operated that each pass is positive or active, the reduction on the first pass being such as to admit of a gradual closing of the screws on each succeeding one.

According to Fox,[6] "Finishing mills are usually operated at temperatures between 288 deg. C. and 399 deg. C. at the hottest point. Tests made by the United States Steel Corporation a few years ago proved that the chilled portion of the roll has the greatest resistance to breakage stresses at about 399 deg. C. The strength diminishes only slightly at lower temperatures down to 177 deg. C., below which point a material weakening was found. At temperatures above 399 deg. C. the strength was found to diminish until, at a temperature of 468 deg. to 538 deg. C., which is a low red heat for cast iron, breakage occurred readily under comparatively light stress."

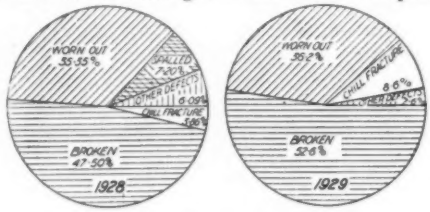


Fig. 6.—Fate of Rolls.

During the whole of the working week close observation should be maintained on the roll temperatures, the rollers' judgment being periodically checked by means of surface pyrometers. As noted above, the surface temperature of the body in the middle should not exceed 400 deg. C., so that the average temperature of the roll will be then well below this figure, as shown in Fig. 2.

When the rate of production is such that it tends to raise the temperature above 400 deg. C., the employment of cooling agents becomes necessary. Two methods of roll-cooling are in general use—namely, cold water sprayed on to the necks and wobblers, and a mixture of steam and air blown on to the body middles. An effective water spray is a closed-end pipe extending the length of the neck, with ¼-in. dia. holes bored at 1-in. intervals, the flow being regulated by an ordinary valve.

The design of steam and air blowers is not quite so simple, and a number of types have been experimented with from time to time. With most of them the steam consumption is extravagant, and efforts were recently made to design a blower that would make the most efficient use of the steam employed. This has been successfully accomplished in a single-jet blower of the design shown in Fig. 3. (Most or all blowers now in use are of the multi-jet type.) The orifice at the emission end is flared to dimensions corresponding to the roll-body length. Following on steam-consumption trials, it was found that a jet of 0.085-in. bore gave satisfactory results, and this size was adopted for the entire roll train. The circular disc shown in the diagram is used for controlling the air supply, and by means of the steam valve and disc a very fine adjustment of the blast saturation temperature is possible. Under normal conditions, a blast saturation temperature of 50 deg. to 55 deg. C. yields admirable results, the roll contours being kept under absolute control.

Obviously, mills fitted with steam-air blowers must be dressed "fuller" than those not so equipped. On 44-in. × 32-in. dia. mills, for example, it was found necessary to reduce the value of the angle θ (Mort') by 0 deg. 54 min.—that is, to close the straight-edge cross by 0.252 in.—the lead gauge thus being thinner by 0.0116 in. With a combination of water sprays and steam blowers in the hands of well-trained rollers, the control of roll contour can be most effective, and makes high-sheet production possible without overheating.

Roll Performance.

Given a roll of right analysis and good physical properties, the question of the "life" or performance arises. British roll manufacturers claim that 12 weeks—192 eight-hour turns—constitute a full life; the life, therefore, is based on time, tonnage produced not being taken into consideration. While users do not accept this basis as being at all equitable, it must be admitted that the subject bristles with difficulties, and it is not easy to suggest a basis acceptable to both makers and users.

For sheet-mill rolls, an equitable basis suggested would be one that covers both weight of roll and weight of sheets (converted to a 24-gauge basis) produced during the "life," that is, a "tons of sheets per ton of roll" basis. At tin-plate mills, where production is calculated in boxes of 31,360 sq. in., the basis would be "base boxes per ton of roll." From experience, a fair range for heavy sheet-mill rolls would be 175 to 200 tons of sheets per ton of roll, and for tin-mill rolls 4,500 to 5,000 boxes per ton of roll. The tin-mill suggestion covers mills of the double-stand type.

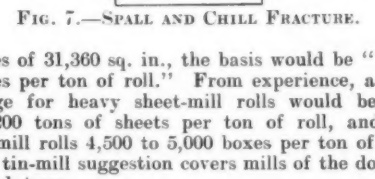


Fig. 7.—Spall and Chill Fracture.

Figs. 4 and 5 illustrate the variation in the life of rolls supplied by several makers. The acid test at all times is the roll cost per ton of sheets produced, and Fig. 4 shows conclusively that there are makers who can supply rolls yielding superior results to those obtained from rolls furnished by some of their competitors. In this chart, cost of rolls from maker *D* was used as a base from which the various percentages were calculated. Referring to Fig. 5, it is seen that a wide range of figures is obtained from various makes of rolls when calculated on the "tons of sheets per ton of roll" basis.

Fox[6] says: "The importance of the question of roll breakages is evidenced by the records of one plant which show that only 15 per cent. of the rolls are discarded, due to the fact that they have been dressed down below the chill. The other 85 per cent. are lost through breakage. Some of the rolls serve over 100 days, and some serve less than 10 days. The average for this plant is about 47 days."

The ultimate fate of rolls at the author's plant during the years 1928 and 1929 is shown in Fig. 6. A salient feature is the disappearance of spalling in the latter period.

(*Continued on page 387.*)

The Constitution of the Alloys of Iron with Silicon.*

By John L. Haughton and Maurice L. Becker.

(Abridged.)

The constitution of the alloys of iron and silicon has been studied by many investigators, but in spite of this large areas on the diagram either remain incompletely determined, or show wide divergences between the results of different workers. It seems probable that these differences, which in some cases involve divergences in temperature data amounting to over 150 deg. C., are in a large measure due to impurities in the materials used.

Much of the earlier work was devoted to the preparation of iron and of the alloying elements in a state of very high purity, which is regarded as essential to the determination of an accurate equilibrium diagram. It is the possibility of using materials of high purity and of employing experimental methods that have been developed in order that the alloys may not be contaminated during melting and observation, that justifies the present re-investigation of an alloy system which has already been studied by many workers.

The iron used in the present investigation was prepared by special methods, starting from electrolytic iron free from sulphur. The composition is given in Table I.

TABLE I.—*Analyses of Materials Used.*

Iron.			Silicon.		
Elements.	Sample I.	Sample II.	Elements.	Sample I.	Sample II.
	Per cent.	Per cent.		Per cent.	Per cent.
C	0.005	0.01	Fe ..	0.04	0.041
Si	0.002	0.02	Al	0.03	0.044
Mn ..	Nil	—	Ca ..	0.017	Nil
S	,,	Trace	Insoluble ..	0.04	0.046
P	0.003	0.002			
Cu ..	Nil	Nil			

The iron used was very carefully freed from oxygen, while other gases were removed by a final melting in a vacuum. In regard to the silicon, complete absence of oxide was not assured, as the material, on solution in acid, left a small insoluble residue which probably contained silica. Care was taken to avoid oxidation or other contamination of the alloys which were prepared and studied in the present research, but it is possible that very small amounts of silica may have been present, although microscopic examination showed no signs of any oxide impurity. The analytical determination of oxygen in alloys of this type is difficult and somewhat uncertain; it was not attempted in the present investigation.

The authors next described the preparation of the alloys, the compositions of which are given in Table II.

TABLE II.—*Composition of the Alloys.*

No.	Silicon. Per cent.	Other elements. Per cent.	No.	Silicon. Per cent.	No.	Silicon. Per cent.	Other elements. Per cent.	No.	Silicon. Per cent.	Other elements. Per cent.
1	24.8	Al 1.88	17	6.9	30	21.0		45	46.6	
2	47.9		18	20.0	31	36.0		46	50.1	
3	19.8		19	63.5	32	28.3		47	54.4	Fe 45.5
4	9.9		20	17.1	33	29.4		48	41.6	
5	31.8	Al 0.02	21	12.3	36	99.93	Al_2O_3 0.01 Fe 0.06	49	50.9	
6	4.8		22	17.1	37	0.5		50	23.0	Al 0.9 approx.
7	13.8		23	62.3	38	1.0		51	52.3	
8	39.4	Al 0.43	24	19.4	39	1.5		52	57.2	Fe 42.8
9	55.8		25	14.6	40	2.0		53	50.6	Fe 49.3
10	53.5		26	11.5	41	90.7	Fe 9.1	54	53.4	
12	31.3	Al trace	27	15.4	42	95.3	Fe 4.5	55	34.2	
15	24.6	Al 0.04	28	17.3	43	87.0	Fe 13.0	56	40.4	
16	2.6	Al 0.02	29	18.4	44	73.1				

* Paper read at the annual meeting of the Iron and Steel Institute.

Heating and cooling curves were taken:—(1) In the high-frequency furnace; (2) in the carborning furnace (using glazed muffles) in hydrogen; (3) in the gradient furnace. These curves were used for determining the lower temperature transformations and the α-γ change point.

The rate of heating and cooling adopted was of the order of 20 deg. C. per min., the points indicated on the diagrams being usually the mean of two heating and two cooling curves. The above rate was found to give concordant results so far as the primary solidification temperatures were concerned, but arrests due to changes occurring in the solid state (for instance, the peritectic reaction near 1,030 deg. C.) showed considerable hysteresis, both on heating and cooling. The divergence, which frequently amounted to 30 deg. C., was found to be lowered by reducing the rate of heating and cooling to less than 10 deg. C. per min. It is noteworthy, however, that the mean value did not vary more than about 5 deg. C., provided that the rates of heating and cooling were about equal.

Magnetic-permeability tests were made on a number of the alloys in order to fix the temperature at which the permeability changed suddenly. The specimens made for measuring the permeability were also used for measuring the dilatation. Heat-treatment was carried out in a thermostat-controlled furnace. In general, the specimens were annealed for a few hours at temperatures not very far below that of the solidus, slowly cooled to the required point, and held there for some hours when the annealing temperature was high, or for several days when it was low. Many of the alloys were very difficult to prepare for microscopic examination owing to their extreme brittleness.

The Diagram.

The results obtained are plotted in the diagram shown in Fig. 1; the various lines and fields are discussed below.

The α Solid-Solution Region.—The liquidus and solidus here keep very close together, and fall from the melting point of pure iron to 1,195 deg. C., where a eutectic with the ϵ phase (the compound FeSi) is formed. The results of the investigation of this part of the diagram are shown in detail in Fig. 2. The curvature of the liquidus in this region is curious. Most of the earlier workers have observed something similar. It is not certain whether the liquidus and solidus actually meet at about 14 per cent. of silicon—they certainly approach very close together. The liquidus and solidus were determined in the usual manner—that is, from thermal curves and quenchings respectively. Owing to the narrowness of the crystallisation interval, it was not possible to detect incipient fusion in quenched specimens, but comparatively large areas were found to have fused as soon as the solidus was passed. The molten portions solidified on quenching and became strongly cored, at the same time the new crystal grains were much smaller than those of the original material.

The ϵ Region.—In this area the liquidus rises steeply to 1,410 deg. C., and falls again to a eutectic with ζ, which occurs at 1,213 deg. C. In the case of the 25-per-cent. alloy the liquidus is raised by about 50 deg. and a second point is introduced, while in the case of the 39-per-cent. alloy the eutectic point is appreciably lowered.

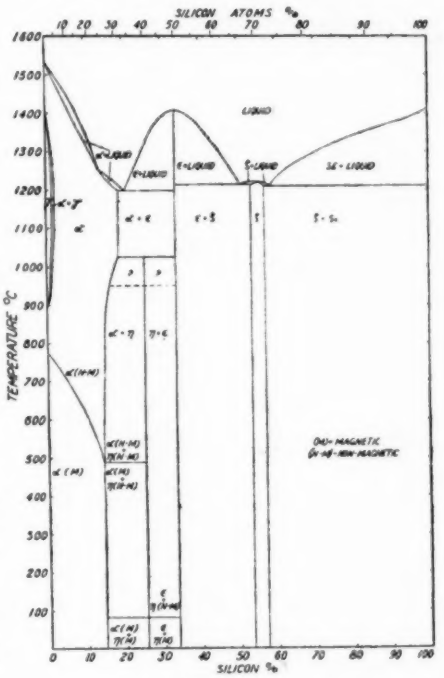


FIG. 1.

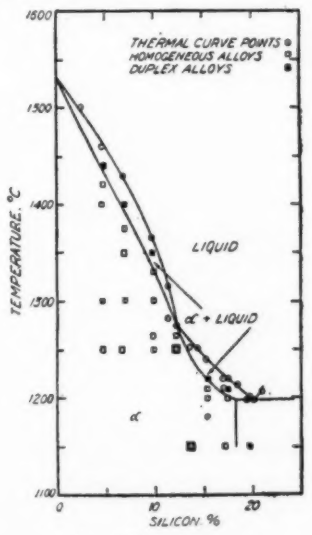


FIG. 2.

In the case of an alloy with 39 per cent. of silicon (which contained about 0.4 per cent. of aluminium) no sign of eutectic structure could be found, the areas which should have appeared as eutectic having the appearance of homogeneous solid solutions.

The ζ Area.—The ζ phase is probably the compound Fe_2Si_3. This area is one in which the

greatest divergence exists amongst earlier workers. Fig. 3 shows the results obtained by the present authors. A solid phase ζ, the mean composition of which corresponds with the compound Fe_2Si_3, separates over a range of composition of 8 per cent., and forms eutectics with ϵ and silicon at about 51 and 59 per cent. respectively. Alloys annealed at 1,195 deg. C. and at 1,000 deg. C. were examined in this area.

The two eutectics occur at temperatures of 1,213 deg. C. and 1,208 deg. C. respectively. The α-ϵ eutectic occurs at 1,198 deg. C. That the melting points of three eutectics should lie so close together is remarkable.

The Silicon Area.—Fig. 4 represents this area. The liquidus rises, at first rapidly, and then more slowly, to the melting point of silicon. The solubility of iron in silicon must be quite

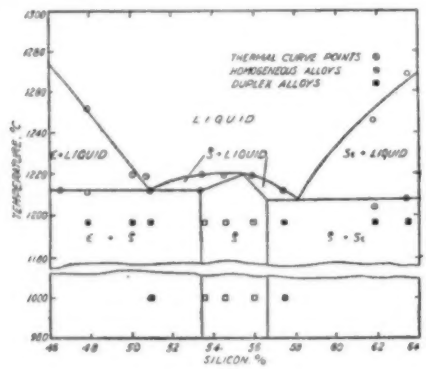


Fig. 3.

small, as an alloy containing 5 per cent. of iron, slowly cooled from 1,150 deg. C. to 1,000 deg. C. and annealed there for 24 hrs., showed large amounts of ζ.

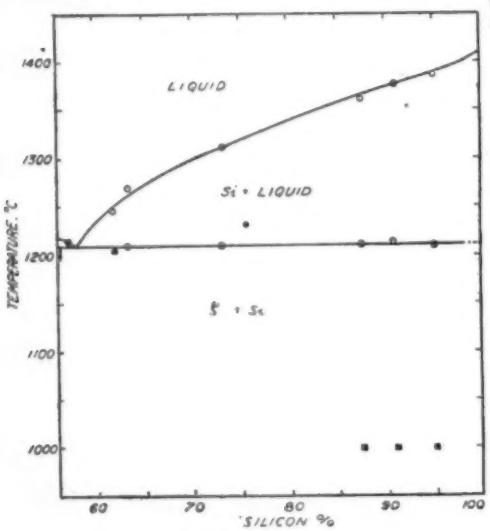


Fig. 4.

Transformations in the Solid Phases.

The α-γ transformation zone is shown in Fig. 1. This has been so carefully worked out by other investigators that it was considered necessary to examine only four alloys. The results obtained agree very closely with the earlier ones.

With regard to the solubility limit of silicon in iron, the homogeneous α area extends to 18.5 per cent. of silicon at the eutectic temperature. With a fall of temperature there is little change of solubility until 1,030 deg. C. is reached, when the solubility falls to 15 per cent. at about 800 deg. C.

Thermal curves show a marked arrest point at about 1,030 deg. C. The points do not lie well on a straight line, either for specimens cooled from the liquid, or for specimens which were annealed for 24 hrs. at 1,150 deg. C. and cooled slowly to 600 deg. C. The position given to the line is, however, probably not very far from the truth. The line was placed at 1,020 deg. C. by Murakami, who showed that the arrests are due to the reaction:

$$\alpha + FeSi = Fe_2Si_3.$$

This interpretation is confirmed in the present work, mainly by magnetic observations.

Many of the alloys showing the arrest at 1,030 deg. C. also showed a very small arrest at 950 deg. C. The arrest was so small as to be masked by minor variations on an irregular curve, but it occurred so frequently on good

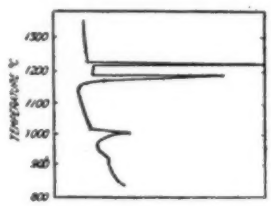


Fig. 5.

curves that there is little doubt that it exists, though, like the point near 1,030 deg. C., it is somewhat variable in temperature. Fig. 5 is a cooling curve for an alloy containing 25 per cent. of silicon taken from above the liquidus. It was thought that the arrest might be connected in some way with that at 1,030 deg. C., the reaction not being completed till the temperature had fallen considerably. A number of alloys were therefore annealed at 1,150 deg. C. for 24 hrs. and then slowly cooled to 700 deg. C. during 6½ hrs. Thermal curves were taken for these alloys at slow rates in the gradient furnace. Owing to the fact that it was not possible to drill the material, it was necessary to place the thermocouple between two pieces of the alloy, which were bound together with nichrome wire.

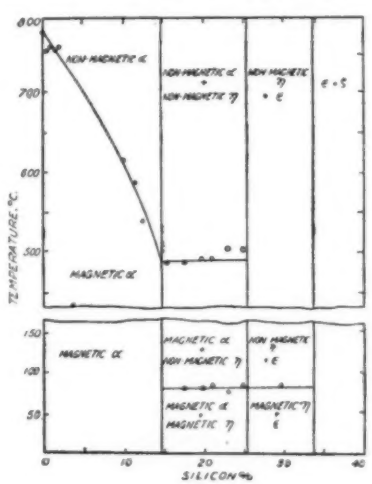

NON MAGNETIC α
NON MAGNETIC α + NON MAGNETIC η
NON MAGNETIC η + ε
ε + S
MAGNETIC α
MAGNETIC α + NON MAGNETIC η
NON MAGNETIC η + ε
MAGNETIC α + MAGNETIC η
MAGNETIC η + ε
TEMPERATURE °C.
SILICON %

Fig. 6.

This gave rise to very poor curves, but there is not much doubt that the point exists.

The microscope throws little light on the question. The alloys are very brittle, difficult to polish and more difficult to etch, but they appear to show no difference between specimens annealed and quenched above and below the line. This is confirmed by the dilatometer, which shows the 1,030 deg. C. point clearly, but gives no indication of a point at 950 deg. C. A dilatation-temperature curve for an alloy containing 23 per cent. of silicon shows the upper point clearly, but no sign of the lower one.

This part of the diagram is in an admittedly unsatisfactory state at present, but it would require a very large amount of further work to clear it up thoroughly.

The magnetic transformation point (β-α) was investigated partly by thermal and partly by magnetic methods. As is shown in Fig. 6, silicon lowers the transformation very rapidly till it meets the η phase boundary at 490 deg. C. and 14.5 per cent. of silicon, after which it runs horizontally to 25 per cent. of silicon (the composition of Fe_2Si_3). The alloys with more than 14.5 per cent. of silicon gave erratic results at first, but it was found that by a previous anneal at 1,100 deg. C., followed by slow cooling lasting about 60 hrs., concordant results were obtained in the magnetic tests. The two alloys with 23 and 24.8 per cent. of silicon contained aluminium, and it will be noted that the points they gave lie at appreciably higher temperatures than the others. The magnitude of the change in these alloys, also, was much greater than in the pure materials, and prevented the possibility of making an accurate determination of the end-point of the horizontal part of the line.

A second magnetic change point was found to occur in these alloys at 82 deg. C. This had previously been discovered by Murakami, who placed the line at 100 deg. C. As the transformation stretches right across the η field, it is obviously a transformation in this phase. It is not a little remarkable that in the case of the alloys of iron with carbon, phosphorus, sulphur and silicon, a magnetic transformation has been found to occur in the intermetallic compound most rich in iron in the series (Fe_3C, 215 deg. C.; Fe_3P, 420 deg. C.; FeS, 296 deg. C.; and Fe_2Si_3, 82 deg. C.). Possibly further investigation would show that it occurred in all such compounds.

Fig. 7, A, is a permeability-temperature curve of an alloy containing 17.3 per cent. of silicon and Fig. 7, B, is that of an alloy containing 21.0 per cent. of silicon. It will be seen that in the former the 490 deg. C. point is larger than the 82 deg. C. point, while in the second the upper point has become quite small compared with the lower one.

Summary.

The constitution of the alloys of iron with silicon has been determined, using materials of a much greater purity than have been available before, and taking every precaution to avoid contamination of the alloys. Very considerable differences exist between the present results and those of the previous observers—differences which are doubtless due in part to the purity of the materials used. The existence of phases which appear to correspond with the compounds FeSi and Fe_2Si_3 has been confirmed, and in addition a phase which is probably the compound Fe_3Si_4 has been shown to exist.

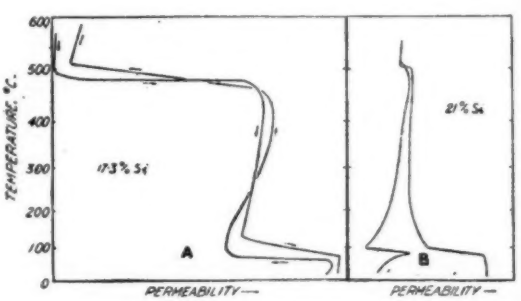


Fig. 7.

German Bunsen Society.—The 35th general meeting of the German Bunsen Society, for experimental physical chemistry, will be held at Heidelberg from May 28 to June 1, 1930. "Spectroscopy and Formation of Molecules" will be the principal theme to be discussed. Applications of persons desirous to participate will be received by the Ortsausschuss der Deutschen Bunsen-Gesellschaft, Heidelberg, Ploeck 55, Germany.

Templates for Assisting in the Rapid and Accurate Costing of Machine-Moulding Operations.

By Anton Raab.

The device and method outlined below provide a useful check for the foundry executive office, and the device will also prove very useful to all foundrymen, especially where a large and varied stock of moulding boxes is kept. In a foundry specialising mainly in machine-moulded castings, different wages are paid for moulding jobs. The works manager has to rely very largely on the diligence of his employees as to how they utilise the pattern plates which are made. In the author's case, the most suitable size of moulding box and the lowest rate of wages to be paid for a particular job can be quickly ascertained in the main or works office by utilising the method sketched below; and, as already stated, the method can be used for check purposes. The owner, manager, engineer, estimator or foreman is able to make a true and satisfactory calculation quickly and accurately. There is no need to mention how important this is at the present time.

Supposing a foundry has the various sizes of moulding boxes shown in the Table. For moulding these boxes the corresponding wages are paid. The table also shows the numbers of boxes of various sizes in stock. The manager, or other head, knows that he has a great deal of work for a particular type of machine (size of box), whereas there is little work for another size of box. It is now up to him to arrange work so that plates can be prepared for the size of box that is not much in demand at the moment, so as to utilise his machines. The prices shown in the table are in Czech currency.* All the sizes of boxes used in a foundry can be reproduced full size as blue prints. It will be well not to go beyond the current sizes, so that the print is not too large, as otherwise the method will not be handy. The print is pasted on to a large sheet of cardboard, and the latter clamped on to a wood frame with reinforcements to prevent it warping. To enable them to be referred to more easily, the different-sized boxes should be outlined with inks of different colours, and the sizes marked in figures on the lines (outlines). The arrangement is completed by a few riders indicating the height of the several boxes, and the whole can be made at very little cost. The frame is set up near the desk, although it can be hung up if desired. The device is very easy to handle. As the boxes are reproduced in their actual size, it is an easy matter to find box piecework price from the table for the particular casting it is desired to make.

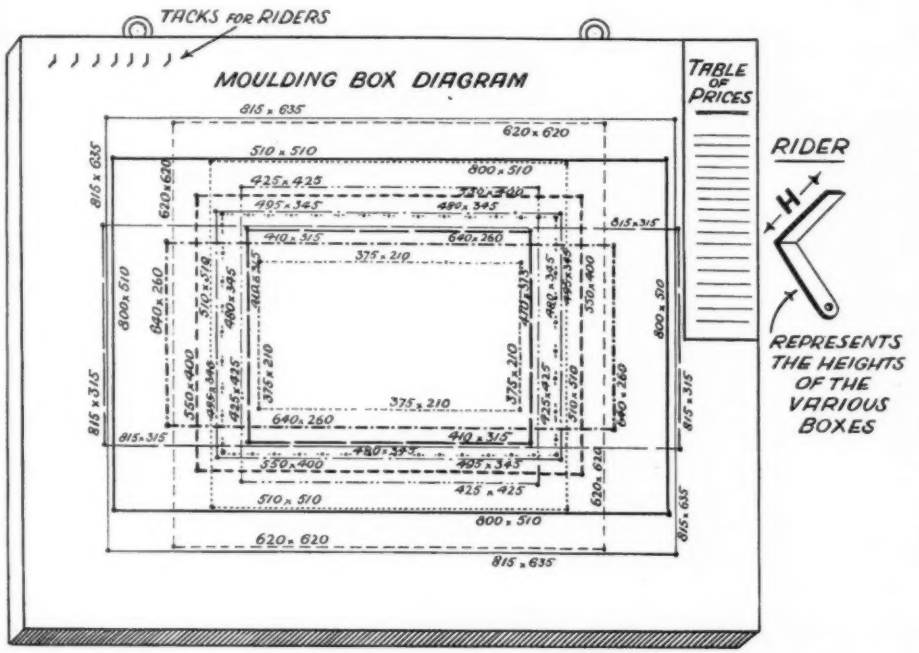


Fig. 1.—Sketch of Board showing Complete Range of Boxes carried for Piecework Price Fixing.

Example.—A firm sends an inquiry for 2,500 bearing castings to drawing or sample. If a sample is available, the prints are referred to until the best box for the casting has been found. The rider gives the height of the box. If a drawing of the desired casting is available, a sheet of paper with the rough outlines of the casting in question is placed on the blue print, and the correct box found as before. From the appearance of the casting and the size of box found, the estimate can easily be prepared from the table.

* One Czech crown = approx. 1.46 pence at the present rate of exchange.

Table of Moulding Boxes.

	Czech crowns.	No. of moulding box parts available.
1. *Small pin-lift type moulding machine, hand-rammed* :—		
375 × 210 × 70 mm. :—		
Ordinary smooth (clean) castings	0.50	460
Standard castings with core	0.60	—
Complex castings	0.70–0.80	—
375 × 210 × 140	0.80–0.90	180
2. *Standard pin-lift type moulding machine, hand-rammed* :—		
410 × 315 × 90 :—		
Very smooth castings	0.90	880
Standard castings with core	0.90–1.10	—
Complicated castings	To 1.40	—
410 × 315 × 110 :—		
Various castings	1.10	84
410 × 315 × 130 :—		
Various castings	1.20–1.30	95
410 × 315 × 200 :—		
Various castings	1.50–1.80	58
3. *Standard pin-lift type moulding machine, hand-rammed* :—		
425 × 425 × 115 :—		
Ordinary plain (smooth) castings	1.80	260
Standard castings with core	2.00	—
Complicated castings	2.20–3.20	—
425 × 425 × 275 :—		
Various deep castings	4.40	68
4. *Square machine, hand-rammed*:—		
510 × 510 × 140 :—		
Quite plain castings	2.30	190
Standard castings with core	2.50	—
Complicated castings with core	2.75	—
Castings on the stripping plate moulding machine	3.50	—
5. *Medium pin-lift type moulding machine, hand-rammed* :—		
480 × 345 × 100 :—		
Quite plain castings	1.25	298
Normal castings with core	1.40–1.60	—
Complicated castings	1.60–2.00	—
6. *Pin-lift type moulding machine, hand-rammed* :—		
550 × 400 × 110 :—		
Quite plain castings	1.80	76
Standard castings with core	2.00	—
Complicated castings	2.20–2.50	—
550 × 400 × 140 :—		
Castings of various heights	To 4.00	46
7. *Square pin-lift type moulding machine, hand-rammed* :—		
620 × 620 × 120 :—		
Quite plain castings	3.50	63
Standard castings with core	3.80	—
Complicated castings with core	To 4.20	—
8. *Pin-lift type moulding machine, hand-rammed* :—		
815 × 315 × 100 :—		
Quite plain castings	2.00	56
Standard castings with core	To 2.40	—
Complicated castings with core	To 3.00	—
9. *Pin-lift type moulding machine, hand-rammed* :—		
815 × 635 × 80 :—		
Quite plain castings	3.60	74
Standard castings with core	3.80	—
Plate castings	4.00	—
10. *Pin-lift type moulding machine, hand-rammed* :—		
640 × 860 × 105 :—		
Quite plain castings	1.50	89
Normal castings with core	1.60–1.80	—
Complicated castings with core	To 2.00	—
11. *Hydraulic pin-lift moulding machine* :—		
800 × 510 × 80 :—		
Quite plain castings	2.20–2.40	92
Normal castings with core	2.60–3.00	—
12. *Turnover plate moulding machine, hand-rammed* :—		
2,000 × 265 × 130 :—		
Long sections with core	7.00–8.00	18
13. *Turnover plate moulding machine, hand-rammed* :—		
2,170 × 350 × 75 :—		
Long sections with core	7.00–9.00	6
14. *Turnover type moulding machine, hand-rammed* :—		
Quite plain patterns	6.00	80
Normal castings with core	7.00	—
Complicated castings	8.00	—

Making a 12-ft. Wheel by a Floor Wheel-Moulding Machine.*

By A. Sutcliffe.

The wheel illustrated in Fig. 1 is made by a floor wheel-moulding machine, as it is too large to be made by a table machine, the largest size a table machine makes being about 7 ft.

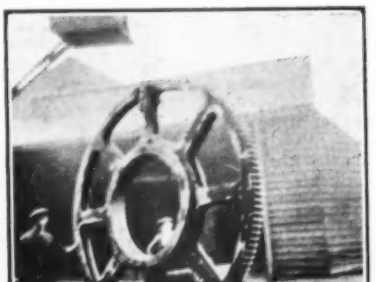


Fig. 1.—12-ft. Wheel made by the Floor Wheel-Moulding Machine.

diameter. This moulding machine (Fig. 2) is used also for making cores and putting turbine blades in the cores; it is worked by a disc and not by change wheels.

The wheel in question has 200 cogs, but the block has only one cog; therefore there is only one cog rammed up at a time. It has been found from experience that the block which has three or four cogs does not make as true a wheel as the block which has one cog. It is double face barred, and the cores to form the arms can

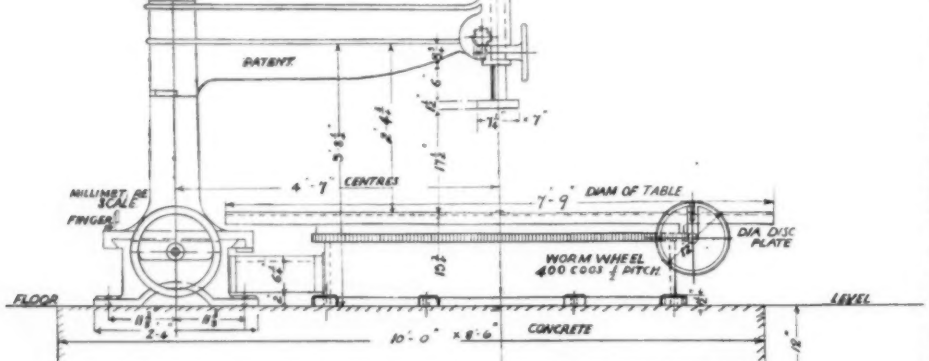


Fig. 2.—Floor Wheel-Moulding Machine.

be made two or three ways: one way is in oil sand, one on top of the other. Having a box, however, it was decided to make them in one—that is, carrying the bottom face bar and bedding the top one in. They are then flush with the face of the wheel and require no prints. The centre hole is formed by a round core 3 ft. 7 in. dia. and 8 in. deep made from two pulley rims, one to form the inside and the other to form the outside with a grid in the centre to strengthen the core; this saves a full 3-ft. 7-in. core.

The rim of the boss is 4 in. thick and the wheel is cast whole, with splitting plates and bolt holes cast in. When the wheel is split, the plates leave the metal very cleanly and there is nothing to do except bolt together. The weight of the casting is 35½ cwts.

* Part of a Paper read by the Author before various branches of the Institute of British Foundrymen.

The Tin Situation.

By "Onlooker."

Last autumn tin stood at £200, and people wondered whether the market would break that level; to-day it is below £150, and at the time of writing the query is whether £140 will not be regarded in a few weeks' time as a comparatively high price. At the end of April, stocks in this country increased by about 2,000 tons, visible supplies registered an increase of about 4,000 tons, whilst the carry-over in the Straits exceeded 5,000 tons. Nor is there much hope that May 31 will see any improvement; rather the reverse, in fact, for although consumption in this country is quite good the position in America is extremely bad and the outlook unpromising.

Some weeks ago, when the standard market in London stood at around £170, there was a wave of optimism. Heavy buying eventuated, and it appeared as if the turn of the tide had come, but this conclusion has proved to be false, although, to the vast majority of people connected with tin, it looked as if an upward movement at that time were overdue. The secondary reaction, as it may be termed, has proved to be more disastrous than the first, and it would be difficult to recall a time in the history of this metal when the outlook has been darker. Indeed, there is at the moment practically nothing to be said in favour of tin, for the restriction scheme, which has been the strength and stay of operators for the rise, has done nothing to help matters. A good deal of misapprehension exists about the 30,000 tons which was announced as the amount of the producers' cut, for this was understood by a good many people to be a cut on last year's total output. Such, however, is not the case, for actually it is a reduction on what the tin producers estimated they would produce *this* year. What the total output for 1930 will prove to be is hard to say, but it is quite certain that at the present time production is definitely in excess of consumption.

When prices are low there is always a tendency to prophecy concerning restriction of output on the grounds that the producers must of necessity be losing money at the existing level. Quite possibly they are, but it does not follow that there is going to be any rush to cut down mine production, which, after all, is a very unpalatable proposition to those interested in the running of the property on the most favourable lines. Stopping the output of a mine entirely usually means the end of that property as a paying proposition, for to commence working again after a lapse of time is very costly and unsatisfactory; even the partial reduction of output makes for very costly working. Among uninformed people there exists an idea that immediately the selling price of any commodity falls below the cost of production, curtailment automatically follows and is pursued until such time as the market quotation rises to a reasonable level once more. Obviously this is incorrect, for it takes time to convince producers of the necessity of bowing to the inevitable and ceasing to produce material which can only be marketed at a price below cost. Tin is only now reaching a level at which, for many properties, its production does not pay, and it will have to remain at this depressed price for some time before the effect is felt.

Those responsible for the present state of affairs are the persons who so stubbornly held up values in the face of increasing production and declining consumption until visible supplies of tin had reached an almost unrealised level. Efforts were made last year by a powerful group to arrest the fall and to keep tin off the market, but they failed, and it is unlikely that any other body will be more successful. The position is now decidedly top-heavy, and only the incentive given to consumption by a really low price can put matters on a satisfactory basis again. Further, this low price will have to be maintained sufficiently long to effect a real change of heart on the part of consumers, who have, as it were, lost the buying habit through being confronted with dear metal at a time when trade has been bad.

Returning to the question of curtailment of production, it must be remembered that the tin producers have had a long run at an average of over £200 per ton, and since their profits at that level must have been considerable it is reasonable to suppose that they have been able to accumulate hidden reserves which they will draw upon up to a point rather than face wholesale curtailment of output. To be optimistic is only human, and it will be strange indeed if the tin-mining interests are not looking for a big improvement in the future.

In spite of temporary improvements on the standard market from time to time, the tin situation is not good, and until America begins again to require her quota in buying, the position cannot even start to improve. As always, the Americans are swinging the pendulum a long way, but with them it is impossible to say when the realisation that things are being pushed too far will come and a movement started in the other direction. No doubt this will be sudden and fairly spectacular, but it must be regarded strictly in the light of a reaction and not as marking any permanent improvement in the situation. That of necessity will be gradual, for the tin position to-day is so bad that only time and patience can put it right again.

Testing Castings for Porosity.—There is often difficulty when producing castings through porosity, these often being untraceable until the casting is put into service; perhaps only one part of the casting may be affected. The best way to detect these porous spots is to coat the outside of the casting with whitewash and cover the internal surfaces with paraffin. If the casting is porous in any place the whitewash will become discoloured in a short time round the parts where the porosity exists. A small degree of porosity can be remedied by doping the casting under pressure with boiled oil and then stoving it at a suitable temperature. This is obviously only suitable for small castings. For larger castings it is best to make up a 5 per cent. solution of sal ammoniac and water, and allow the casting to stand in this for about 48 hours. The sal ammoniac will penetrate the pores of the porous iron and, if the porosity is not too great, will effectively seal them. Such treatment will be found effective for such castings which have to hold liquids under pressure and must therefore show no porosity.

The Poumay Cupola.

COMPARISONS WITH STANDARD PRACTICE.

DISCUSSION.

Mr. Longden said that he had been fascinated with Mr. John Cameron's description of the theory and working of the Poumay cupola and felt much indebted to him for taking so much trouble and pains in the preparation of the Paper. He thought that most others would feel the same.

Mr. Laurie thought that such results as had been shown were what everyone in the foundry trade would like to achieve, and asked Mr. Cameron how he handled the metal coming out of the cupola at 13 tons per hr. for the class of work that he did. He thought that in a general foundry using at the most 20 tons per day there would be some difficulty in handling it in so short a time. What would Mr. Cameron advise in such a case? It appeared to him that it would be necessary to have a very large well if the same cupola were installed in a general shop. He thought that perhaps a receiver would be necessary. It was quite a different matter in foundries where the cupola could be kept running all the time.

Mr. Cameron, in reply, said that in his own practice they used a small tilting ladle under the cupola spout and two bogies were always ready to receive the metal, one on either side of the ladle. The cupola, after the tapping hole was once opened, was kept running all the time except for slagging. If they found it necessary to store metal it was taken away in 10-cwt. bogies and teemed into a large ladle. They found no difficulty in collecting any quantity required. The well of the Poumay cupola was rather larger than in an ordinary cupola.

Comparison with an Ordinary Cupola.

Mr. McFarlane said that Mr. Cameron had explained very fully the claims, theory and working of the Poumay cupola. In his opinion there was only one point about a cupola and that was to obtain the lowest consumption of coke per ton of iron melted. Mr. Cameron had shown them that he had made some progress, but he still claimed that the Poumay cupola does not work as economically as those at Messrs. Shaw (Glasgow), Limited. He had calculated 15 cwts. of coke for the bed of the Poumay cupola, but Mr. Cameron had told them it was 22 cwts., and that made the ratio of coke still more favourable to Shaw's cupolas. Mr. Cameron had said that the shape of the Poumay cupola was bottle-necked. In the discussion on the Paper which he presented to them in January a gentleman had said that that was old-fashioned and he would like something better. He thought that as a matter of fact it did not matter much what the shape of the cupola was, as some people got good melting with parallel and some got good results with bottle-necked furnaces. Kirk, in his book, showed all shapes of cupolas, bottle-shaped with neck up and with neck down and straight-sided. He had good points for every shape he showed in the book. With regard to the Poumay cupola, he thought that more material and labour would be required, and certainly the bed would have to be higher with the auxiliary tuyeres. Cupola practice was a very debatable question and one could say a great deal about it, but as the Paper was really confined to the Poumay he thought it better not to say more at the moment.

Mr. Cameron, in reply, referred to Mr. McFarlane's interesting Paper, which, unfortunately, he had been unable to hear. He congratulated Mr. McFarlane on the results he was obtaining, as these were exceptional. In the case of an ordinary cupola, he would prefer it built with parallel sides. In the case of the Poumay, the boshing was part of the deliberate design and willingly adopted. The Poumay cupola certainly required a deeper bed than a normal one having one row of tuyeres.

Mechanical Charging.

Mr. McFarlane: Would Mr. Cameron tell them how he charged his cupola? There were great differences in the manner of charging cupolas.

Mr. Cameron replied that he had no mechanical charging arrangements. The coke and the iron were charged by hand. He was interested to find when visting Ford's foundry in America that they had thrown out mechanical chargers and were using hand labour. When M. Poumay was at Kirkintilloch, he expressed pleasure at the manner in which the cupola was charged, and specially congratulated him on it. That was entirely hand-charging.

A Member asked if there was anything in the blast entering at a tangent. Was it not the case that the air would take the line of least resistance and that was to go straight in towards the centre?

Mr. Morehead asked what sort of pressure of blast Mr. Cameron used. He himself worked at about 32-in. water gauge, and wondered what Mr. Cameron meant when he spoke of the Poumay working at a high blast pressure.

Mr. Cameron replied that he was not quite sure of the pressure, but perhaps Mr. Jeffrey could give that information.

Mr. Jeffrey said that the pressure varied between 16 and 18 ozs.

Preparation of Charge.

Mr. James Miller said that, like a few other people, he had found the furnace question a somewhat tough problem to solve. They all had their own ideas about what the best cupola arrangement should be. Mr. Cameron had mentioned the Greiner and Erpf cupola, and, if his memory did not fail him, that addition to the furnace was put out of action because the tubes choked themselves. In spite of what Mr. Cameron had said, he thought that the auxiliary tubes in the Poumay would get choked. Mr. Cameron had mentioned slag getting into them, but he had difficulty in understanding how slag got so high up the furnace. With regard to charging, did Mr. Cameron break the pig-iron into more than two pieces? The size of the material charged had an important influence on the furnace working.

Choking of Tuyeres.

Mr. Cameron replied that, as he had pointed out in the Paper, the choking of the supplementary tuyeres was largely dependent upon the correct adjustment at the beginning. He was so fortunate as to have the assistance of M. Poumay, who made the initial adjustments of his furnaces and he had experienced no trouble. Had he been obliged to start the furnaces himself, it was quite possible that some trouble may have arisen.

Mr. James Miller said he understood Mr. Cameron to say that the tubes did choke.

Mr. Cameron replied that what he did say was that occasionally some slag was found round an opening of one or two of the auxiliary tuyeres. In his experience, the tubes did not choke, and this had not happened during a run of four to five hours. He had no experience of long runs of ten hours or over, when, possibly, there might be a greater tendency in this respect.

Products of Combustion.

Mr. Affleck said that he took it that in general the Poumay cupola aimed at generating carbon monoxide at the lower levels, and this passing through the incandescent coke resulted in more perfect combustion. He would like to ask, did the CO burn at the charging door or did it not? He understood Mr. Cameron to say that the pressure rose during the cast; was that due to increased quantity of air or increased resistance due to choking? Was it a case of adjusting the volume of the air supply and maintaining it all through the run?

Mr. Cameron replied that with regard to Mr. Affleck's first point, he may not have made himself quite clear. In his old furnace, prior to conversion, they had gases containing about 10 per cent. CO which burnt at the charging door, but in the Poumay cupola the CO was reduced to 0.5 per cent., which was too little to burn. There was no flame and, consequently, no heat inside the charging door; it was so cool that one could almost sit in it.

Regarding the air supply, they adjusted the volume and kept it constant throughout the cast. Any increase of pressure he thought would be due to increased resistance.

Mr. Laurie asked what was the proportion of heads and runners to pig-iron, and what proportion of pig-iron to scrap did Mr. Cameron charge? That was a point often lost sight of in comparing cupolas. If the scrap was in large pieces, such as he often had, and required two men to get it into the furnace, it was a very different thing to light scrap from rain-water stuff. The light scrap was also higher in phosphorus.

Mr. Cameron could not give the proportion of gates and runners off-hand. He used more scrap than was produced in the foundry, having to buy in engineering scrap, some of which was of considerable size. The mixtures varied from 50 per cent. pig and 50 per cent. scrap to 75 per cent. pig and 25 per cent. scrap. The pigs were dumped out of wagon on to blocks and were generally broken into three pieces.

A User's Views.

Mr. Longden said that Mr. Cameron's remark about the heat at the charging door interested him, as he had in mind a 36-in. cupola that worked so coolly at the door that one could put his hand in and a piece of paper would not scorch. It was therefore evident that the advantage in that respect did not rest entirely with the Poumay. Mr. Cameron had been fortunate inasmuch as he had been able to make a lot of comparisons between two cupolas working side by side on the same work. He himself had only been able to compare a cupola which he had had in the past with the Poumay which he now worked. In the Whiting cupola he had previously, he required 4 cwts. coke for the bed and 9 per cent. coke for fusion, which gave an overall consumption of just about 10 per cent. coke. With the Poumay cupola which he was working at present the bed coke was 900 lbs. and the fusion coke 8 per cent. The overall result was therefore very much the same—practically 10 per cent. He thought that excessive claims had been made on behalf of the Poumay cupola, although there were some which could be substantiated. He had noticed that in melting there was not the usual loss of silicon. At first he set his charges with the usual allowance for silicon reduction, but found that it did not take place. He was puzzled about that for some time, but Mr. Cameron had explained why the loss did not occur in a very interesting manner. He had already drawn attention to the tendency for metal to melt high up in the Poumay cupola. That might not be of any moment in the class of work which Mr. Cameron did, but he could see serious disadvantages where high-duty metal was being melted. He noticed that Mr. Cameron gave the average tapping temperature as 1,350 deg. C.

Mr. Cameron explained that the temperatures given in the tables were all taken by optical pyrometer and were given for comparative purposes. The usual correction was to add 100 deg. C. to approximate actual temperature.

(*Continued on page* 384.)

A Note on Nails.

By H. Littlehales.

The meaning of the phrase "tenpenny nail" was unknown until Dr. Murray, of the Great English Dictionary, read through the accounts of the mediæval churchwardens of St. Mary-at-Hill, by London Bridge. In these accounts the wardens set down the cost of much ironwork, and Dr. Murray discovered that tenpenny, sixpenny and other priced nails were sold at tenpence, sixpence, and so on, the hundred. Under date 1427 of the Early English Text Society's edition of these accounts we read:—

"For iiic Xpeny nayl 2-6.
For iiiic VIpeny nayl 2-0."

And many other similar instances occur of various other similarly-priced nails.

If one examines a number of the bills and account-books of mediæval English builders, one is impressed with the immense number of types of nails that were used. There were single nails and double nails, the distinction between them not being very evident. Tacks, and horseshoe nails, clowte, stub, gullet, scoring, white, black, lath, lead and roof nails, English and Spanish nails are mentioned, but not our useful friend the French nail. Great nails known as spikings and middle spikings were used, the largest of which, known as "double spikings," must have been, one may imagine, something like a 10-in. nail. A quantity of these were used in the fifteenth century for the repair of the bridge which crossed the Thames at Westminster.

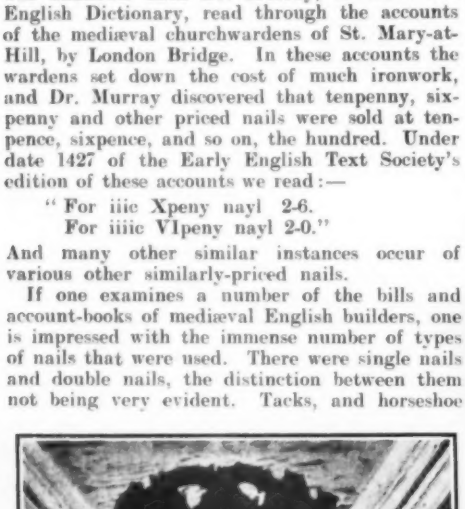


Fig. 1.—A Wood Carving of Three Nails on the Choir-Vaulting, Winchester Cathedral.

All nails were sold by the "iremonger," as ironmongers were then called. Draught nails are mentioned, but the explanation of the name has not yet been discovered. Sprig or "sprygg nayll" were small nails costing about 1½d. the hundred. "Silt" nails are included, but only very rarely, and their use is not easily determined. They were expensive, costing 14d. the hundred.

Certainly nails of the exact form of those used by gardeners and cast by foundrymen of to-day were in common use in the opening years of the sixteenth century. This is known from the interesting carving in wood of three nails on the vaulting of the choir of Winchester Cathedral. These three nails, shown in Fig. 1 (reproduced by courtesy of Mr. Cave, of Petersfield), are each about 2 ft. in length, and they are carved in such high relief that they might almost be separately fixed to the shield on which they rest. They are painted the colour of wrought iron, not the lighter colour of a casting. This is probably due to the fact that the artist was unaware of the distinctive colouring of each kind. We may suppose him to have classed all nails as being of an "iron" colour.

This question of the colour of the three nails is of interest. The carver and painter appear to have taken wholly different views. The carver represents the cast-iron nail; the painter, clearly with an eye to the historic use of these particular nails, portrays them as of wrought iron.

One of the oldest nails in England is probably that in the Museum at Winchester. This nail, of a grey colour, still rests firmly in the stone roof slab which once sheltered a Roman villa in Hampshire. There is nothing remarkable about this nail; so far as appearance goes it might be a galvanised nail of to-day. Patternmakers now sometimes, and carpenters often, carry their nails in the pouch of their aprons or in a linen bag attached, just as they did 500 years ago. Nails have been used in England for some 2,000 years, and references to them abound in literature of all periods.

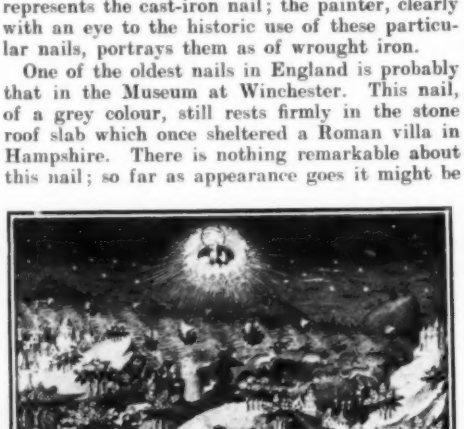


Fig. 2.—From a XVth-Century Prayer Book of Henry VI. Nail Box and Labourer with Hammer are shown on the Roof.

Before the sixteenth century the nail stood alone and supreme as a fastener of timber-work, but since then the screw has in a considerable measure taken its place. Ordinarily the largest nail in use to-day is the 6-in. French nail. Murray's Great Dictionary gives an interesting reference to the use of nails in wheels in the fourteenth century:—

"As nails are in a wheel without
That with the wheel are turned about."

Pig-iron well stacked weighs 1 ton for every 8 cub. ft.; loosely stacked, say, approximately 10 cub. ft. per ton. Heavy scrap weighs 1 ton for every 14 cub. ft.

Hardening Drills.—Drills for heavy duties may be hardened by heating the drill gradually in a charcoal fire until it is almost bright red in colour. It should be then removed from the fire and plunged into mercury. The drill when working should be fed with a mixture in equal proportions of camphor and turpentine.

The Poumay Cupola.

(*Continued from page* 383.)

Mr. Longden: Oh, a correction for black body condition! He took it that Mr. Cameron melted very highly-phosphoric iron when he obtained the lowest coke figures. When semi-steel was melted, Mr. Cameron had explained that the consumption was higher—that was, of course, to be expected. He had found that his own Poumay cupola was a very efficient melter, but he was of the opinion that an ordinary cupola, properly handled and given as much attention and adjustment, would give just as good results. The iron could be got just as hot and fluid. He thought that the claims for the Poumay furnace were too great. It might be that the lining was a little less worn and show a slight saving over a long period, but he had not yet been able to determine that.

With reference to the question of one or two rows of tuyeres, he personally had worked with both and not noticed very much difference in melting. The disadvantage of two rows was that more bed coke was required.

Mr. Cameron replied that the question of flame at the charging door of the cupola depended largely upon the height of the charging door from the tuyeres. A cupola should be properly designed as to the height of stack, and then it would, when fully charged, show little flame. At the end of the day, after charging was stopped and the level of the charge fell, there was flame in the Poumay. He saw at one foundry a Poumay cupola with the charge let half way down the stack, because the man could not keep pace with the charging. In this case there was a continuous flame. His own men did the same at the start because they were unprepared for such fast melting. With regard to the use of one or two rows of tuyeres, in an ordinary cupola, he would prefer one row, but found that there was a tendency to bridge unless they were properly designed. One row well designed was undoubtedly to be preferred in an ordinary type of cupola.

Mr. J. Currie said that he had had some experience of working a Poumay cupola and obtained good results, but he had found, as Mr. Cameron mentioned, that the Poumay was not as elastic as an ordinary cupola. Since installing the furnace he had obtained an improvement in melting practice.

Catalogues Received.

Steam Valves.—Messrs. Hopkinsons, Limited, of Huddersfield, in List No. 2170 describe and illustrate their patent "Stamstel" valve. It is fabricated from forged-steel bodies and covers, stainless-steel spindles and Platnam—a special alloy—for the valves and seats. The modern concept of business is exemplified by the last two words on page 16 of the brochure—"Inspection invited." Such a gesture certainly gives confidence to the buyer, as indicating that the manufacturers have 100 per cent. confidence in their products and methods of manufacture.

Moulders' Safety Boots.—Messrs. Allen & Caswell, Limited, of Kettering, have sent us a leaflet (No. J. 279) which describes and illustrates the "Regent" moulders' safety shoe. The uppers are of dull grain leather and the bottoms of "all-leather" English bend soles. They rather resemble the old-fashioned elastic-sided boots, but instead of the insert of a length of elastic, an overlapping division is made and the two halves of the boot are secured by a strap-and-buckle arrangement. The boot gives complete security from splashed metal, and has quite a smart appearance—a rather unusual factor in this line of goods.

South Cave Sand Quarries Reorganised.

Through the joint enterprise of Yorkshire Amalgamated Products, Limited, of Doncaster, and General Refractories, Limited, of Sheffield, an interesting departure has just been carried out at the South Cave sand quarries, near Hull. Plant of the most up-to-date kind has been installed for the milling, grinding and disintegrating of the sand used by foundries in various parts of the country, and particularly in the East Yorkshire district, and this plant was formally set in operation on Friday, May 2, by the Lord Mayor of Hull (Councillor R. Richardson).

The quarries, which are 30 acres in extent, have great supplies of bonding sand and silica sand. A face of about 40 ft. consists, for the upper 10 ft., of red bonding sand, and for the remainder of yellow silica sand, belonging to the Upper Jurassic beds. Hitherto these sands have been sold separately, but they require to be mixed for use, and it is now the intention of the joint firms to supply them ready mixed in varying proportions to suit the requirements of the foundry industry. The mixing will be carried out under the supervision of the technical staff of the companies. The plant, which has been supplied by the Brightside Foundry & Engineering Company, Limited, of Sheffield, is driven by an oil engine by Messrs. Robey & Company, Limited, of Lincoln. The sand, after being ground and mixed, is elevated to a disintegrator, which aerates it, and it is then passed direct into a wagon, a railway siding running up to the mill. The sale of the output of the plant and quarries is in the hands of General Refractories, Limited.

The Lord Mayor of Hull, who was supported by representatives of the two companies interested in the development, and also of the city and the foundries of Hull, severed a tape placed across the entrance to the new plant, then placed the first shovelful of sand in the mill and started the machinery. Afterwards a luncheon was held at the Royal Station Hotel, Hull. It was presided over by Mr. F. Metcalfe Fisher, of the Bramcote Sand Company, near Nottingham, who is associated with Yorkshire Amalgamated Products, and among others present were the Lord Mayor of Hull, the Sheriff (Councillor F. Till), Messrs. Frank Russell (chairman and managing director of General Refractories, Limited), R. A. Kirkby, T. Singleton, G. Senior (directors), F. G. Foster (director of Yorkshire Amalgamated Products, Limited), W. H. Fenton (Hull Foundry & Engineering Company), E. W. Oakes (chemist and technologist to Yorkshire Amalgamated Products, who is in charge of production at South Cave) and E. V. Taylor (Divisional Goods Manager of the London & North Eastern Railway).

Mr. Russell on Foreign Competition.

MR. FRANK RUSSELL, in proposing "The City and Trade of Hull," said the matter which had brought them together that day was an example of enterprise on the part of two firms—Yorkshire Amalgamated Products and General Refractories—whereby the former, having discovered and possessed themselves of deposits of two rather remarkable sands at South Cave, joined hands with the latter to produce from those sands certain mixtures which might be relied upon to serve the needs of the British foundry industry. Too much to-day was British industry dependent upon imported goods. In foundry sands, the Continental sand importers had been provided by nature with a mixture which, though variable and to some extent unreliable, was nevertheless almost ready for use. There at South Cave they had two sands, neither of which would serve the purpose for what they were intended if used singly, but which, when mixed together and milled in the plant which they had inspected, produced a regular and reliable material which would, they hoped, serve to stem the tide of foreign importations of sand and enable the country to be more independent than hitherto of foreign sands. There was also the effect upon the Hull engineering industry to be considered. Engineering and shipbuilding was bound up to some extent with the production of castings; castings were made in Hull; Hull had hitherto had to import its supplies of foundry sands from some districts further west than South Cave. It was hoped that South Cave would in future help at any rate to supply the moulding sand needed at Hull.

In meeting foreign competition, they were playing a game with opponents whose dice were loaded. In this country there was a certain standard of living; they had certain charges to meet; there were certain impositions upon their business which they could not avoid. Their competitor knew none of the restrictions from which they suffered—there were not the same calls upon his pocket. Although he (the speaker) could quite see that any general policy of safeguarding or protection which might restrict imports was not necessarily bound to be universally popular in Hull, he would draw their attention to the fact that we in this country must produce in accordance with certain conditions, certain rates of wages, and certain hours, and, having made a profit, must pay 4s. 6d. in the £ to the Government. The point he was trying to make was that our ports were to-day open to the unrestricted importation of goods which had been produced in conditions which would be unthinkable in this country, and which would be illegal, and, though he was not there to advocate any general policy of protection, he did say that our Government, whatever that Government might be, in imposing certain charges upon British industry, ought at any rate to go so far as to say that it would impose upon goods imported from abroad in competition with British goods some charge which would level matters up. (Hear, hear.)

THE LORD MAYOR OF HULL, in reply, said he did not regard the institution of any new factory, wherein labour would be employed, as anything of a small matter, though it might be small in itself. He thought that any company or group of companies, that had the pluck, foresight and energy to institute a works, were performing an extremely useful service to the community.

THE SHERIFF, as chairman of the Development Committee, wished the industry prosperity. He was looking forward to the time when they would supply not only sand, but gravel, and so on, for their great industries.

MR. F. G. FOSTER, in proposing "The Foundry Industry," said it was one of the foundation industries of the age, because without the art of casting in metals all our modern civilisation as we knew it would be utterly impossible. He thought the city of Hull might congratulate itself on possessing that industry in remarkable variety. They had the foundry industry as applied to heavy machinery, such as that for the crushing of seeds and the extraction of oils; they had also the foundry industry as applied to light castings; in fact all branches of the foundry industry, from the heaviest to the lightest, were represented in the city. For some considerable number of years his company had supplied those sands to certain iron founders, and also to steel founders, in Sheffield, Manchester, and elsewhere, who possessed the necessary machinery and were prepared to go to the trouble of mixing them in the precise manner and proportions to get the sand which they required for certain foundry purposes. The development which they had now undertaken was in the provision of a well-thought-out and well-laid-out plant to put themselves in the position of supplying to iron founders and steel founders a great variety of mixtures ready for use, and to be relied upon to an extent to which sands which were known as natural bonding sands could not be relied upon by reason of their variability. They hoped in that way to make those sands at South Cave available and useful to a number of firms, both there and elsewhere, who had not up to the present been able to use them because the company were not in a position to supply them ready for use. If they could do that, they would have achieved their principal object, and he thought their reward would follow in due course, as it always did to those who were able to be of real service to their customers.

MR. W. H. FENTON, in reply, said the state of the trade was rather precarious, and there never was a time when a fillip was required so much as at present. He hoped the day was not far distant when, instead of the majority of them working under-time, they would be working over-time; and when that day came he felt sure that General Refractories would participate in the boom. They all hoped that the new venture would have beneficial effects throughout Hull, and they wished the promoters of it every success.

THE CHAIRMAN proposed "The Allied Firms—General Refractories, Limited, and Yorkshire Amalgamated Products, Limited." He said the latter, in their engineering organisation, had something which was very helpful to the former.

MR. THOMAS SINGLETON (director and commercial manager of General Refractories, Limited), in response, said it was five years since they and Yorkshire Amalgamated Products came together. He thought there was an idea more or less simultaneously in the minds of Mr. Russell and Mr. Foster that if the two companies were going to do any good at all, either individually or collectively, they had to give some sort of service to the people who used their goods. This was only a beginning. He believed that the two companies, in allying themselves not only in that venture but during the years that had gone by and the years that were to come, were helping to serve the trade in some way better than they were able to do as separate entities.

Institute of British Foundrymen.

NEWCASTLE BRANCH.

The annual general meeting of the Newcastle Section was held at the Neville Hall, Newcastle-upon-Tyne, Mr. Robert Smith presiding.

Mr. Arthur Logan was elected to the position of President, Mr. F. Allan Senior Vice-President, and Mr. R. J. Shaw Junior Vice-President.

Mr. J. N. Simm was re-elected honorary treasurer and Mr. F. Sanderson, who was not present at the meeting owing to indisposition, as honorary secretary.

The following were elected members of Council: Mr. C. R. Vander Ben, Mr. W. Scott, Mr. J. D. Nicholson, Mr. T. C. Fortone, Mr. J. Watson and Mr. J. Blythe.

Mr. V. Stobie and Mr. J. N. Simm were re-elected as representatives to the General Council, and Mr. Spencer was again elected lanternist.

MR. STOBIE proposed a vote of thanks to Mr. Smith for the way in which he had conducted the meetings during his presidency, and also proposed that a letter should be sent to Mr. Sanderson expressing their thanks for the work he had done during the past session. MR. SMITH briefly replied to the vote of thanks and said that everybody had helped to make his term of office a successful one.

Weight of a Solid Cast-iron Ball can be quickly estimated by dividing the cube of the diameter by 7.4, the result being in pounds. This rule is for all practical purposes correct.

Comparative Rail Transport Costs.

BRITISH *v.* FOREIGN RATES.

By J. W. Parker, A.M.Inst.T.

From time to time general statements are made alleging that rail rates in this country are on a much higher level than those on the Continent, especially for the raw materials and finished products of the heavy industries. For the most part, the vagueness of any comparison or its patent inequality rob it of all interest and usefulness. The London Chamber of Commerce, however, has done a public service recently not only in investigating but in ventilating before the Royal Commission on Transport now sitting some illuminating facts as to the real position. These comparisons, covering iron ore, iron and steel scrap, iron castings, machined castings, railway castings, gratings, baths, etc., in Holland, Belgium and Germany are of particular consequence to the foundry trade.

Comparison Favours Continent.

Figures are given in each case for consignments of 2, 5, 10 and 15 tons. For the purpose of conversion, the rates of exchange per £1 have been taken as 12 Dutch guilders, 20 German marks and 170 Belgian francs, an allowance which it will be admitted is somewhat conservative in the circumstances. For iron and steel scrap, the 2-ton rate in England is 31s. 8d., in Holland 29s. 6d., in Germany 43s. 9d., and in Belgium 27s. 8d. The initial comparison certainly does not show Germany as a country of very low rail charges. If, however, 15 tons be taken England comes out at 17s. 10d., Holland at 12s. 4d., Germany 12s. 5d., and Belgium 5s. 9d. This immediately shows Britain to be in the most unfavourable position. With ordinary iron castings, one notices the English charge remains constant at 31s. 8d. per ton whether 2, 5, 10 or 15 tons be sent. In Holland the comparable rates range between 29s. 6d. per ton to 16s., whilst in Germany the extent is bounded by 54s. 10d. on the one hand and on the other 28s. 8d. In Belgium, 2 tons are rated at 27s. 8d. per ton and 15 tons at 10s. 6d. For light castings, the relative figures are much the same save that the English rates are all at 49s. 9d. per ton throughout the graded wagon loads. Machined castings in 2-ton loads are 31s. 8d. a ton in England and 29s. 2d. for 5-, 10- and 15-ton lots. The highest rate in Holland for the same goods is only 4d. more than the lowest English figure at 29s. 6d., whilst for 15 tons it sinks to 16s. Germany starts at 2 tons, considerably higher than any of the other three, at 43s. 9d., but is appreciably lower than the English figure for the maximum weight at 23s. 8d. Belgium is again in the most favoured position, as its rates do not exceed 27s. 8d., whilst at the lower end they are down to 10s. 6d. a ton. Stoves and grates in England are higher at every point than any of the Continental countries cited, with a maximum of 46s. 8d. and a minimum of 38s. 1d. Holland's comparative figures are 29s. 6d. and 16s., Germany's 43s. 9d. and 28s. 8d., whilst Belgium is once more lowest between the limits of 27s. 8d. and 12s. 4d.

Hitting the Foundry Industry.

The tale can be repeated with practically the same figures in respect of cast-iron gratings and with small modifications in the case of railway castings as well as iron and steel bars. Although the list could be prolonged, the principles underlying the wide difference will be apparent. Whilst the margin between Dutch, German and Belgian quotations has an intrinsic interest of its own, the main point likely to concern the British foundry trade is the real disadvantage imposed on the British industry by these lower transport charges in force on the Continent. If the home industry loses trade, it is of small consolation to know which of these European competitors gains the advantage; sufficient is it to know the bare facts. Even a cursory examination of the rates shows the cause of lower Continental figures to be in the larger wagon-loads. All the countries mentioned save Britain give greatly reduced charges for larger loads, but the reduction afforded by home railways is either trifling or non-existent. One cannot imagine the German founder carrying on any extensive export trade on the basis of a 2-ton rate which at 54s. 10d. is 23s. 8d. a ton in excess even of the high English figure. If, however, he deals in 15-ton lots he cuts the British quotation in half, whilst the home manufacturer gets no benefit at all.

A Mutual Benefit.

As the figures speak for themselves, it is quite unnecessary to labour the adverse effect of this arrangement upon home manufacturers, especially in their attempt to compete in the export trade. It is, of course, argued that our own rail-charging system should be adapted along Continental lines in order to give more favourable quotations for bigger wagon-loads. By so doing both the railways and the heavy industries as a whole would benefit. Since it costs very little more to haul a wagon of 10 tons than it does to carry one containing 2 tons, the railways could well afford to give a concession for the larger quantity. At the present time the average load of goods, as distinct from minerals, on British lines is less than 3 tons, notwithstanding the fact that the standard wagon is a 12-tonner. That is not to say every wagon will hold 12 tons, because the bulk of merchandise differs so greatly, but in practically every instance a considerable advance upon 3 tons can be attained if some inducement in the shape of a lower charge per ton is forthcoming. In effect, what is needed is a practical partnership between the railways and the railway users. Already this has been contemplated in the provisions of the Railways Act of 1921 in a very broad manner, but something more practical is needed for the foundry business. What is required is a reduction sufficient to induce the trade to use its brains to load wagons up to capacity. To take an example of what is intended, one might instance a rate of 37s. per ton for Class 11 goods conveyed a distance of 186 miles. With a 2-ton load, the truck will earn £3 14s. for the railway company. If, however, the wagon is loaded to its extreme capacity with 12 tons, it is proposed to charge £10 14s. for the whole truck. This works out at 17s. 10d. a ton instead of 37s. The result is, both the manufacturers and the railway gain, the one in a reduced tonnage rate and the other in larger earning and higher profits, simply because the trucks are loaded up to the limit.

Consigning Bath Tubs.

Considered from another angle, the proposed method is analogous to that in force for road vehicles to-day. If a commercial motor-lorry is used at the present time, the charge is made for the whole vehicle on the understanding that it is loaded up to the full extent. In this aspect the subject has a direct bearing upon road competition, since the reduction in charges which would follow better loading would place the railways in a stronger economic position in relation to conveyance by road. It has been pointed out that the ordinary stove grate is a good illustration of what might be done. At the present time the loading of stoves is about 30 cwts. to the truck, but if the back of the stove is taken away it becomes nothing more than a cast-iron plate which can be loaded to the extent of 10 tons to a truck, always provided there is sufficient inducement to do this. Again, one might take cast-iron baths. In this country no attempt was made to produce an article which would give a high wagon-load, simply because there was no advantage to be gained in transport costs. In Germany, on the other hand, baths were cast without feet in order to allow them to be "nested" and thus enable them to get the benefit of the 15-ton load and at the same time to avoid the very high 2-ton rate. There is also another conspicuous advantage in nesting and securing the large wagon-load, and that is, the cost of packing is greatly reduced whilst the protection is automatically increased. When the cost of packing a single bath is two and a-half times the value of the article itself this point will be appreciated at its true worth.

It will naturally be pointed out that in this country manufacturers can have the benefit of exceptional rates in certain instances, but this immediately raises questions of difficulty, because it is almost impossible for any particular individual to know all the exceptional rates which may be issued throughout the country, as they are not published in the ordinary way but only appear in the rate-books at the two stations concerned. In Germany, where tariff or scale rates are in force, any and every manufacturer can obtain the use of all quotations as they are issued, a practice which prevents favoured firms from having an undue advantage. As things are in Great Britain it is quite possible that of two firms situated in different parts of the country, one may be paying, say, £1 a ton more for a line of export goods than its rival, simply owing to the existence of a good exceptional rate in one area which does not exist in the other.

With small consignments in Germany, there is a system whereby traffic agents collect packages and load them into 15-ton wagons at a rate which is actually lower than the railway's own quotation for similar articles. In this way do the traders of that country avoid the high rates for small lots in those instances where they cannot avail themselves of the wagon-load figures by their own efforts. In the same manner the organisation known as the American Express Company operates across the Atlantic.

By introducing some practical co-operation along the lines indicated the railways would give very real assistance, not only to the foundry business but to the heavy industries as a whole. The principle has already received a limited amount of utility in so far as Classes 1 to 6 of the mineral divisions such as coal, limestone, and heavy iron and steel are concerned. Its extension is now advocated to take in the remainder of the heavy trades. So far as the lighter and distributive manufactures are concerned, more caution would be needed, but this is really outside the scope of the present article.

It will be noticed that no mention has been made of service and facilities in the comparison of British and foreign rates. The greatest difference in this respect probably lies in the more severe demurrage and rent regulations in force on the Continent. Instead of the customary 48 hrs. allowed in Great Britain, about half the period is the rule in Germany, whilst in some instances in Belgium the period is as low as 8 hrs. When compared with the very substantial preference in the way of rates, however, these minor points are of little consequence and hardly affect the competitive position at all.

Pattern Wax.—A good wax for use with patterns can be made from equal parts of carnauba wax and soft yellow beeswax. The two should be melted and well mixed together. The resultant wax will be found to be tough and will not break or crumble, whilst it has sufficient hardness to resist the pressure of the sand during moulding.

Tin- and Sheet-Mill Rolls: Their Treatment, Etc.

(*Continued from page* 378.)

Premature Failure in Service.

The premature failure of rolls may be classified under the following heads:—

(1) *Complete Breakage.*—These fractures are of various types:—(*a*) Straight through body middle, (*b*) diagonally across bodies at varying angles, (*c*) through neck fillet and extending diagonally across the body, (*d*) straight through fillet and (*e*) fractured wobbler.

(2) *Cracked Body.*—Occasionally a fissure appears in a roll, which does not extend completely through. It may only be as deep as the chill, or, as sometimes happens, a few inches only of the core holds the two portions together. This type of failure is very rare.

(3) *Spalling.*—This may be defined as the chipping away of the body extremities, from the bearings outwards (see Fig. 7).

(4) *Shot-Holes.*—The depth of these holes varies, with a corresponding extent of damage to the sheets being rolled. When the shot-holes are so deep as to render it impossible for the cold-rolling mill to remove successfully the embossments or protuberances on the sheets, the roll must be returned to the lathe for further dressing, or scrapped when this proves ineffectual.

(5) *Mottle.*—This term denotes rough patches on the body, due to exhaustion of the solid chill.

(6) *Chill Fracture.*—This is a disruption of the chilled skin, pieces of varying extent and depth leaving the core. The depth of the cavity

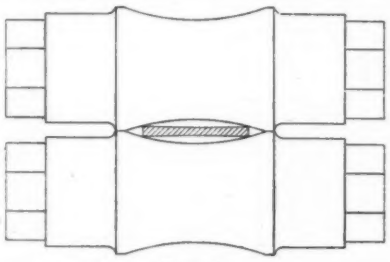


Fig. 8.

corresponds roughly with that of the chilled skin (see Fig. 7).

(7) *Damage caused by the Entry of Tongs, etc.*—Ocasionally the injury to rolls is superficial and easily repaired. Sometimes, in the case of old rolls, the chill approaches exhaustion, and the damage proves irreparable.

Causes of these premature failures are dealt with below:—

(1) *Breakage.*—There are numerous causes of roll breakage; the maker is responsible for a proportion, while the remainder are due to the user.

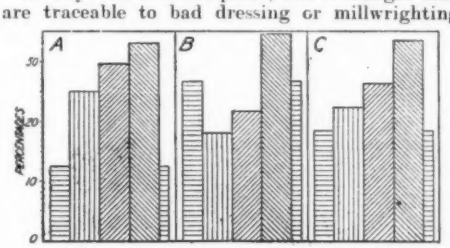
Dealing with the maker's responsibilities, it is essential that the analysis be such as to ensure maximum strength, and that the physical properties be of a sufficiently high standard to produce the requisite degree of surface finish. The specification of the grade of surface finish rests with the mill operator, and this should be done with the full knowledge that endurance and high finish are qualities that are not always embodied in one roll. Usually one of these two properties is gained at the expense of the other.

The mill operator's views on finish having been conveyed to the maker, the responsibility for analysis is the latter's entirely. The unfortunate divergence of opinion among makers on this fundamental question is the cause of much discussion when the user attempts to trace a breakage to faulty analysis, and thus hold the maker accountable. It is the practice, at this plant, to analyse samples of rolls that have rendered good service, and the figures given at the commencement of the Paper are a fair average. Unquestionably the analyses of rolls that have survived very few shifts in service have differed considerably from these figures, usually in the carbon, manganese and silicon contents. In these cases there has been no hesitation in ascribing the failure to faulty analysis. Cases may be cited of rolls carrying either high carbon, manganese or silicon, that have yielded a very short life under first-class working conditions.

Regarding chill depth, there is a consensus of opinion among makers and operators that about $\frac{3}{4}$ in. is desirable. As already stated, the chill should be regular in depth, on both top and bottom ends. It is possible for the user to measure the chill on the ends only, but it is often discovered—usually after a breakage—that the depth increases towards the middle, sometimes to the extent of $\frac{1}{2}$ in. Whilst departure from the specified depth of, say, $\frac{3}{4}$ in. is not in itself a cause for rejection—rolls bearing $1\frac{1}{2}$-in. chills have given excellent service at these mills—it is often found that, when rolls have broken after a short life, the chill on the body middle has been heavy, with an analysis showing high carbon and silicon contents. When a roll bearing an eccentric chill is heated, there is a variation in the intensity of the internal strains corresponding with the differences in the chill depth, and this is a cause of breakage for which the maker usually accepts responsibility without question.

Given a good roll, as defined in the first section, its longevity will depend on its treatment by the mill operator. Roll turning, grinding and millwrighting are dealt with on col. 2, page 377.

At any well-directed plant, roll breakages that are traceable to bad dressing or millwrighting



A = 1928. *B* = 1929. *C* = average of *A* and *B*.

Fig. 9.—Seasonal Breakages.

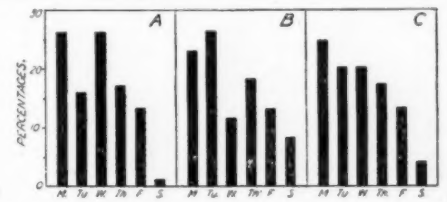
very seldom take place. The first effect of these faults is discernible in the inferior product sent from the mill affected; inferior product should always call for prompt corrective measures.

Too rapid heating on the warming-up shift or during preheating by "artificial" means may cause a breakage on that or the succeeding shifts, due to the difference in the coefficients of expansion already referred to. Frequent and violent fluctuations in the roll temperature make it more susceptible to breakage, especially in the case of very hard rolls; hence all possible steps should be taken to maintain the mills at a safe predetermined working temperature. While the lowering of a mill's temperature may be accomplished fairly easily and safely by means of a steam and air mixture, the restoration of heat to a mill after rapid cooling is attended by great risk. In the case of mills unequipped with gas heaters, the mill must be raised again to the working temperature by rolling, and it frequently happens that conditions in the mill at these periods are not favourable to safe working, owing to the rapidly changing contour of the rolls and localisation of stresses. To illustrate this point, suppose that a mill or set of mills has to cease rolling in the primary or intermediate stages of a heat, because of, say, an engine stoppage or other trouble. Should the idle period be of such duration as to cause an appreciable alteration in the roll contour, obviously the shape of the semi-finished packs (in section) in the furnaces will not conform to that of the rolls in their changed condition. The concavity of the rolls will have increased, and therefore undue pressure will be exerted on the edge of the pack as it passes through (see Fig. 8); the result will be a flow of steel to the middle, with undue strains thrown on the rolls at that point, which will often result in a straight break through the centre. In order to restore heat to the body middles quickly, and thus regain the lost contour, narrow packs should be rolled, and the customary draft somewhat reduced—following on with the semi-finished heat when the objective has been reached.

The temperature at which the necks are maintained is also a prime factor. When this is excessive, the outward flow of heat from the body middles is retarded, due to the smaller differential, and this conduces to a gradually climbing body temperature, which, if not checked, soon rises to danger point. Again, on very hot necks, it is impossible to ensure efficient lubrication; hence it is easy to see that, unless promptly attended to, a breakage due to high temperature alone may quickly ensue. With one hot neck only the danger is still present, a diagonal body breakage often resulting, due to the stresses of varying intensity set up at either end of the roll.

But it very often happens that a breakage occurs when a mill is in an ideal condition and producing excellent sheets. When this takes place, it is usually discovered that the cause lies in excessive draft.

A question often discussed among mill operators is whether the susceptibility of a roll to breakage is greater at one season than at another. A series of charts based on two years' operations is submitted, which may prove interesting. Fig. 9 shows the percentage of breakages for the various seasons: winter (comprising January, February and December);



A = 1928. *B* = 1929. *C* = average of *A* and *B*.

Fig. 10.—Daily Breakages.

spring (March, April and May); summer (June, July and August); and autumn (September, October and November). In 1928 (Fig. 9, A), it will be observed that the order is:—Winter, 12.50 per cent.; spring, 25.00 per cent.; summer, 29.55 per cent., and autumn, 32.95 per cent. During 1929 (Fig. 9, B) this order was changed, the position now being:—Spring, 18.05 per cent.; summer, 21.30 per cent.; winter, 26.25 per cent., and autumn, 34.40 per cent. Combining the figures for the two years (Fig. 9, C), the order becomes:—Winter, 18.10 per cent.; spring, 22.15 per cent.; summer, 26.15 per cent., and autumn, 33.60 per cent.

It is commonly believed that cold, frosty weather has a detrimental effect on rolls, and Fig. 9, B, tends to confirm this opinion, but Fig. 9, A and C, may be used in refutation. It should be noted, however, that when atmospheric temperatures are low, precautions for protecting the hot rolls against keen drafts are usually redoubled.

Fig. 10, A, B and C, shows the days of the week on which breakages occurred. Here again it appears difficult to draw any useful deduction, excepting perhaps that on Mondays the breakage hazard is at its maximum.

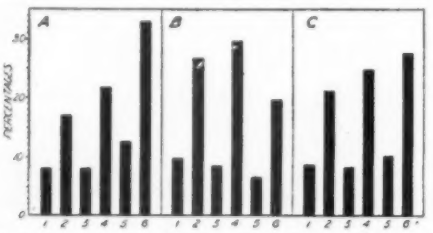
A further view commonly held is that the risk is greater during the first part of a shift than later, owing to the freshness of mill crews, etc., following on a break between shifts, but Fig. 11, A, B and C, does not confirm this. In these charts the numbered columns represent the initial and final 2 and 6 hrs. respectively of each 8-hr. shift: Period 1 is 6 to 8 a.m.; period 2, 8 a.m. to 2 p.m.; period 3, 2 to 4 p.m.; period 4,

4 to 10 p.m.; period 5, 10 p.m. to midnight; and period 6, midnight to 6 a.m. During 1928 (Fig 11, A) by far the major proportion of breakages took place during period 6, and steps were taken to ensure closer supervision during the night-shift, with the result shown for 1929 (Fig. 11, B).

The proportion of top and bottom rolls broken in all mills was as follows:—

1928: Top 56.80 per cent., bottom 43.20 per cent.; 1929: Top 52.46 per cent., bottom 47.54 per cent. Top rolls thus preponderated slightly.

Regarding leading and trailing mills (there are four leading mills in the train), the figures for 1928 are:—Leading mills, 23.86 per cent.; trailing mills, 76.14 per cent. Of the leading mills rolls, 71.45 per cent. were tops. In 1929, only 13.12 per cent. of the rolls broken were leading



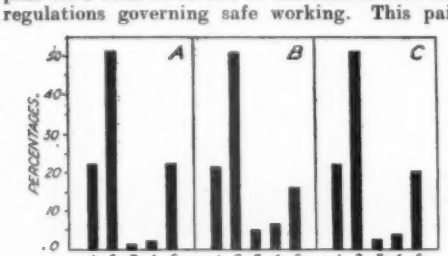
Periods: 1 = 6 to 8 a.m.; 2 = 8 a.m. to 2 p.m.; 3 = 2 to 4 p.m.; 4 = 4 to 10 p.m.; 5 = 10 p.m. to midnight; 6 = midnight to 6 a.m.

A = 1928. *B* = 1929. *C* = average of *A* and *B*.

Fig. 11.—"Time of Day" Breakages.

mill rolls, and of these 62.50 per cent. were tops. From these figures it appears evident that the torsional stresses play a minor rôle so far as roll breakages are concerned.

In Fig. 12, A, B and C, is shown the percentages of rolls broken at the various stages of the heat, and it is obvious that the first matching pass is the most dangerous to the roll. The chief contributory cause of breakages on this pass is the lack of judgment on the part of rollers in realising the influence of the length and temperature of packs on the strain placed on the rolls. To illustrate: A pair of bars is drawn from the furnace at the correct working temperature and rolled to stipulated length, the first pass after matching being given after the screw-pins have been slackened in accordance with the regulations governing safe working. This pair



Stages: 1 = roughing; 2 = first matching pass; 3 = second matching pass; 4 = running over; 5 = finishing.

A = 1928. *B* = 1929. *C* = average of *A* and *B*.

Fig. 12.—"Stage of Heat" Breakages.

may be followed by another at a lower temperature, in consequence of which—unless due precautions are taken—the length before matching is too short. The result is a matched pack cooler and thicker than its predecessor, and, unless the screw-pins are adjusted to compensate for these two adverse factors, the risk of breakage is raised appreciably.

That the human element is solely responsible for a proportion of the breakages is indisputable, and charts (Fig 13, A and B) are submitted bearing on this point. Here the rollermen are graded according to breakages due to overdraft over two lengthy periods. The results shown for the first period (Fig. 13, A) were unsatisfactory, but, following on close supervision and careful coaching on draft, the progress evident in the second period (Fig. 13, B) ensued.

Furnace design and operation, if faulty, will contribute to breakage by producing bars and/or packs improperly heated. Here, again, the rollers' judgment plays its part in estimating the temperature and deciding whether a bar or pack should be passed through the rolls.

(2) *Cracked Body.*—As already mentioned, this type of failure is very rare; the causes may be identical with those responsible for complete breakage, or may be the same as those producing chill fracture.

(3) *Spalling.*—Generally, spalling is due to faulty mill conditions, of which the following may be enumerated: (*a*) insufficient chamfering by the roll-turners; (*b*) rolls constantly maintained too "hollow"; (*c*) body length too small to accommodate properly the width of sheets rolled; (*d*) high roll temperature; and (*e*) splashing of water from necks on to body.

(4) *Shot-Holes.*—Allison[2] states that these are due to casting the roll at too low a temperature.

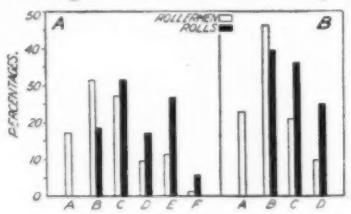


Fig. 13.—Rollermen and Rolls.

Frequently the trouble is barely discernible on the lathe, the shots dropping from the roll whilst in commission.

(5) *Mottle.*—These rough patches may be evenly distributed over the body face and thus be attributable to regular but shallow chill, or they may appear unevenly and thus be ascribed to an eccentric chill. Again, a ring of mottle encircling the roll is often seen at a certain distance from the top end of the body, this distance corresponding to the position of the joint in the two chill sections used by the founder when casting.

(6) *Chill Fracture.*—From investigations made on rolls that have failed from this cause, it is concluded that the defect is due either to: (*a*) Chill of uneven depth, with its resultant irregular coefficients of expansion; (*b*) occluded gases in the grey-iron core directly beneath the chill; or (*c*) a chill having a too sharply defined line of demarcation between itself and the core. Frequently (*b*) and (*c*) are both found in one roll, and Allison[2] attributes them to a high casting temperature.

REFERENCES.

1 B. H. Thwaite: *Proceedings of the South Staffordshire Institute of Iron and Steel Works Managers*, 1892–1893, vol. viii, p. 14.
2 A. Allison: "The Manufacture of Chilled Iron Rolls." London 1929. Sir Isaac Pitman & Sons, Ltd.
3 J. Mort: *Paper read before the Swansea Technical College Metallurgical Society*, Feb., 1929.
4 J. S. Caswell: *Proceedings of the South Wales Institute of Engineers*, 1926, vol. xlii, p. 119.
5 W. H. Melaney: *Blast Furnace and Stee lPlant*, 1926, vol. xiv, p. 232.
6 G. Fox: *Iron Trade Review*, 1923, vol. lxxiii, p. 665.
7 K. Younghusband: *Iron and Coal Trades Review*, 1928, vol. cxvii, p. 832.

B.S. Specification for Brass Tubes and Screwed Glands for Condensers for Land Purposes.—The British Engineering Standards Association has recently published a specification dealing with brass tubes and screwed glands for condensers for land purposes upon similar lines to the specification issued in 1921 for tubes and glands for marine purposes. The present specification, however, provides for eight sizes of screwed glands, from ⅝ in. to 1½ in. inclusive, and has, as in the case of the specification for marine purposes, clauses covering the quality of material, the dimensions of the tubes and the glands and mechanical and hydraulic tests. Copies of the new specification (No. 378—1930) may be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria Street, S.W.1. Price 2s. 2d., post free.

Book Review.

German-English Dictionary of Technical, Scientific and General Terms, by A. Webel. Published by Messrs. George Routledge & Sons, Limited, Broadway House, 68-74, Carter Lane, London E.C.4. Price 36s. net.

This book, though not specially compiled as a foundry dictionary, adequately meets all demands placed upon it. The reviewer admits that he is not expert in the German language, only having retained a fair proportion of college-gained instruction, but, after all, his case is perhaps fairly representative of the British industrialist. To test the directory, we used it to translate a few advertisements in "Die Giesserei" (the German foundry-trade periodical). An announcement translated ran as follows: "Our shockless jar-ramming moulding machines, particularly the small jarrer with squeezing mechanism for direct lift, also with turnover apparatus, is the sturdiest machine amongst our moulding machine productions." Again, in a second advertisement "annealing cans" are dealt with—they are called tempertöpfe in German. Whilst the complete word is not listed "tempergüss," "temperofen" and other words lead one to the clue of malleable iron and annealing, whilst "topf" is given as "pot, jar or crock"; these indications, together with a knowledge of the industry, soon produce the correct translation. An interesting feature of the dictionary is its orientation as a telegraphic code. An ingenious system has been used whereby each page carries a 2-number indication and each word a 3-number designation. Thus five numbers identify any word in the whole dictionary, and as ten are allowed for transmission, two words can be sent for the cost of one. Obviously, the numbers can be converted into letters forming a private code.

We are satisfied that, intelligently used, this dictionary can be of great service to those with a limited knowledge of German, but with this knowledge there must be an ability to split up the long German words into their component parts. Finally, we would congratulate both author and publisher in the production of a really intelligent scientific German-English dictionary. Curiously enough, our favourite French dictionary is published from the same house.

The Birmingham Metallurgical Society.

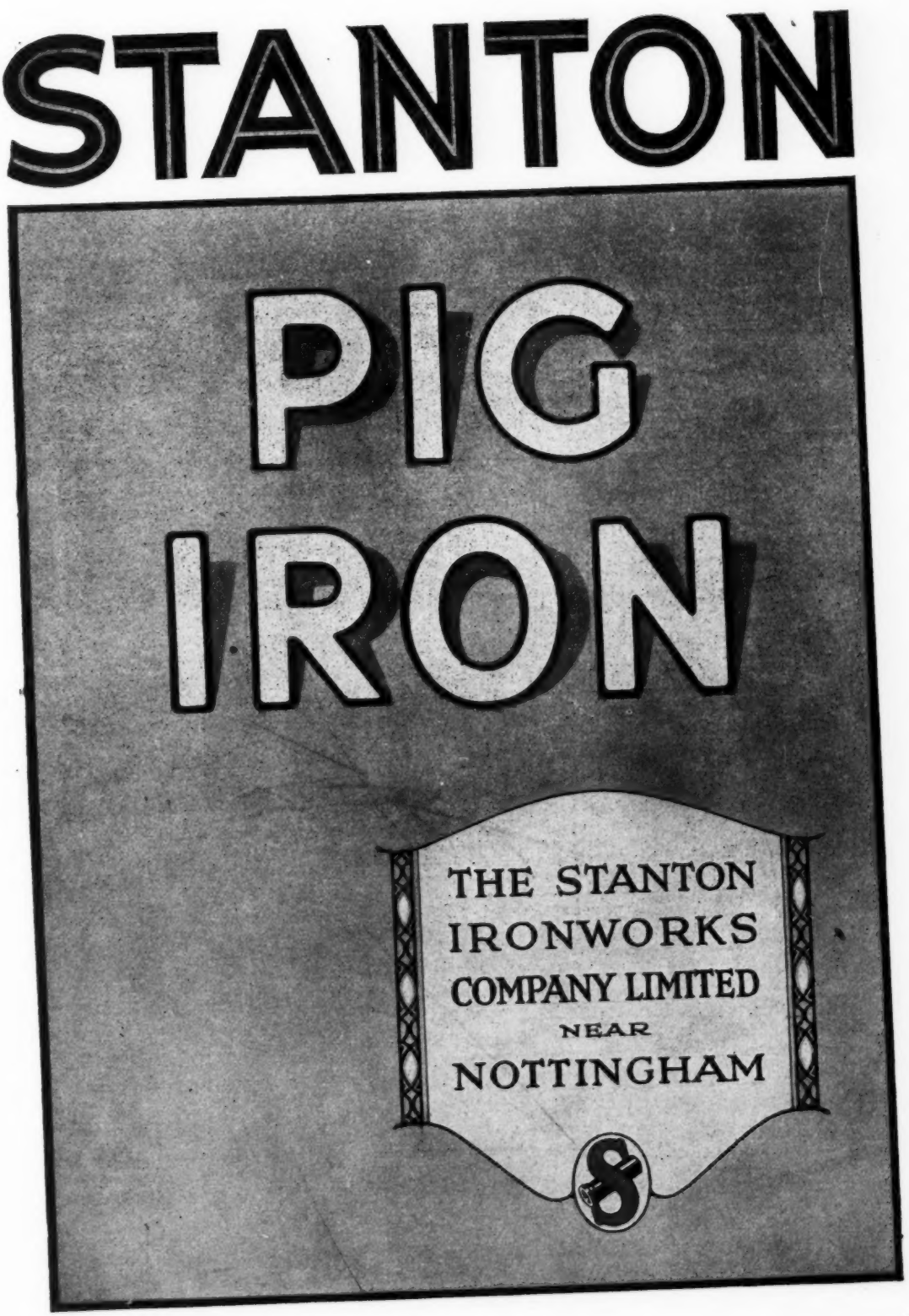
The Adjudicating Committee of the Birmingham Metallurgical Society announce the following subjects for the thesis upon which the Society's Annual Medal and Prize will be awarded for the current session:—(1) Recent developments in the study of the corrosion of metals and methods of protection; (2) a critical study of the application of heat-treatment to metals, or (3) the application of electricity in the production and purification of metals.

Candidates have to select one of the foregoing subjects, and the thesis must be submitted in accordance with the following conditions:—

The Council of the Society offers annually the Society's Bronze Medal and Prize, or Prizes, to the value of five guineas, for the best essay or essays submitted on a metallurgical subject to be announced each year by the Society's Adjudicating Committee, provided that in their opinion the essay or essays submitted are of sufficient merit. The following persons are eligible to compete for this award:—(*a*) members of the Society under thirty years of age, and (*b*) metallurgical and chemical laboratory assistants under thirty years of age, being past or present students of technical schools in the geographical centre of Warwickshire, Staffordshire and Worcestershire, now engaged in industrial practice and not having had a University training.

Correspondence or inquiries should be addressed to the secretary, Mr. F. G. Tustin, 83, Chinnbrook Road, Yardley Wood, Birmingham.

XUM


STANTON
PIG
IRON
THE STANTON
IRONWORKS
COMPANY LIMITED
NEAR
NOTTINGHAM

Trade Talk.

The Belgian output of steel castings for March was 10,210 tons. The French output for the same month was 22,000 tons.

The registered office of the London Iron and Steel Exchange, Limited, is now at 28, Essex Street, Strand, London, W.C.2, where all communications to the secretary should be addressed.

A site is being cleared in Sheffield to make room for extensive additions to the works of Messrs. James Neill & Company (Sheffield), Limited, makers of hack-saw blades and frames, permanent magnets, etc.

Messrs. General Refractories, Limited, of Sheffield, have received an order from New Zealand for their new high-alumina firebrick, the "Dreadnought," for use in connection with oil-fired furnaces.

The Hunslet Engine Company, Limited, Leeds, have received an order from the Crown Agents for the Colonies for a 2-6-2 type locomotive, metre gauge, with outside cylinders 15 in. by 22 in., for the Tanganyika Railway.

The Chairman (Sir Frederick Henderson) stated at the annual meeting of the Iron Trades Employers' Insurance Association, Limited, that 1930 was their jubilee year. It was in 1880 that the Association was founded as a department of the old Iron Trades Employers' Association in Manchester.

Messrs. A. M'Millan & Son, Limited, one of the oldest shipbuilding firms on the Clyde, have announced that their yard will close at the end of the present month. Since completing four motor-ships some months ago the stocks have been empty, and the firm has not received an order for three months.

Owing to the large accumulation of stocks and the serious depression in trade, about 50 per cent. of the workers in the Singer factory at Kilbowie were recently placed on a four-day working week. The situation has now grown even more serious, and from May 16 the remainder of the workers will have their period of employment curtailed to five days per week. The factory will be entirely closed on Saturdays.

Messrs. G. A. Harvey & Company (London), Limited, Woolwich Road, London, S.E.7, have just completed the first of a number of welded mild-steel transformer tanks, ordered by the Central Electricity Board for the South-East England scheme. They are intended for working at a capacity of 15,000 k.v.a., 132,000 volts, 50 cycles, three-phase, and are fitted with "Harco" pattern mild-steel gilled tubes for cooling purposes.

The system of rationalisation in the shipbuilding industry was discussed at the conference of the Federation of Engineering and Shipbuilding Trades at Blackpool last week. A resolution was carried expressing the opinion that the shipbuilding employers should give alternative employment or compensation to workers who lose their jobs through the rationalisation process. The resolution also requested the shipbuilders to meet the Federation with a view to considering the whole problem.

Contracts Open.

Belfast, June 4.—Pumping plant, for the Belfast Water Board. Mr. W. I. Quinn, secretary, Water Office, Belfast. (Fee £1, returnable.)

Glasgow, May 26.—2,200 yds. of 10-in. dia. water pipes, etc., for the District Committee of the Middle Ward of the County of Lanark. Mr. G. T. Frew, 227, West George Street, Glasgow. (Fee £1 1s., returnable.)

Leeds, May 24.—Iron and steel stores, for the Gas Committee. The Town Clerk, 26, Great George Street, Leeds.

Matlock.—3,600 tons of cast-iron pipes and specials, and 5,600 tons of mild-steel pipes and specials, for the Ilkeston and Heanor Water Board. Mr. A. E. Smith, engineer and manager, Waterworks, High Peak Junction, near Matlock.

Steel Spring.—An experiment has shown that a steel spring 5½ in. long, 9's gauge, ½-in. pitch, with a 1-in. hole, will support a weight of 21 lbs. The compression was $\frac{1}{16}$ in.

Personal.

Dr. Robert J. Anderson has resigned as vice-president and director of the Fairmont Aluminum Company, of Fairmont, West Va.

Lt.-Col. H. H. Johnson and Mr. A. W. P. Macwhinnie have been elected directors of Messrs. Andrews Toledo, Limited, Sheffield. Lt.-Col. Johnson is the general manager of the company.

The Hon. Roland Kitson, a director of Messrs. Dorman, Long & Company, Limited, was elected President for 1931 at the recent annual meeting of the National Federation of Iron and Steel Manufacturers. Mr. W. Simons, managing director of the British (Guest, Keen, Baldwins) Iron & Steel Company, Limited, and Mr. James Henderson, a director of the United Steel Companies, Limited, were elected additional vice-presidents of the Federation.

Mr. John Curry has been appointed works manager of the Dunston coke works of Priestman Collieries, Limited, as from July 1, when the firm will take over the Team By-Product Coke Company's works. Mr. Curry has been manager of the Team Company's works since 1917. He is an ex-chairman of the Northern Section of the Coke Oven Managers' Association, a member of the General Council of the National Association, and a member of the Northern Coke Research Committee.

Wills.

Heaton, A., a director of Messrs. Heaton & Dugard, Limited, Shadwell Street Mills, Birmingham, metal and wire rolling-mills £113,390

Willetts, William, of Old Hill, Staffs, a director of Messrs. Burton, Delingpole & Company, Limited, British Castings (Old Hill), Limited, and Tube Fittings, Limited £13,831

Obituary.

Mr. Walter Gale, works manager of Messrs. Archibald Kenrick & Sons, Limited, of West Bromwich, died recently, aged 56.

Mr. D. B. Somerville, of Messrs. J. & W. Somerville, Limited, Caledonian Nail Works, St. Ninians, died recently at his residence in Stirling.

Mr. J. P. Kincaid, a mining engineer and chief surveyor with the Shotts Iron Company, Limited, died in Edinburgh on May 14, after a very short illness. He was president this year of the Scottish branch of the Institute of Mine Surveyors.

Mr. Ernest Partridge, managing director of Steel Nut & Joseph Hampton, Limited, Wednesbury, died recently, aged 66. Mr. Partridge joined the Steel Nut Company, Limited, in 1892 as managing director. In 1897 the firm amalgamated with Messrs. Joseph Hampton, Limited, and he continued as head of the joint concern, holding the position until the time of his death.

We regret to announce the death of Mr. George Reid Ure, J.P., a prominent Scottish ironfounder, at his residence, Hopepark, Bonnybridge, on May 16. Mr. Ure, who was 83 years of age, was head of the firm of Messrs. Smith & Wellstood, Limited. He was a native of Falkirk, and after serving an apprenticeship he became a partner with his father in the ironfounding business of Ure & Company, Bonnybridge, later becoming managing director of George Ure & Company, Limited. In 1890 the firm became amalgamated with Smith & Wellstood, Limited, and Mr. Ure was appointed managing director of Smith & Wellstood, Limited. This position he held until about three years ago, when he retired from the active management, although he remained as chairman and director of the firm until his death. He is survived by a family of two sons and two daughters, of whom Mr. George Albert Ure is the present managing director of Smith & Wellstood, Limited.

Preserving Cotton Driving Ropes.—These may be preserved by melting together 8 parts of beeswax and 5 parts of resin, and applying the mixture to the ropes with a soft brush. Manilla ropes may also be treated in a similar manner. If the process is repeated at regular intervals the life of such ropes is greatly increased.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

2,392. Cope, H. A. (Waters, A. C.). Cores for use in casting metals. 326,927.

5,207. Nasmyth, Wilson & Company, Limited, and Manson, D. Locomotives. 326,959.

6,411. Wallis, G. L. Tube joints. 326,972.

6,762. Christiansen, P. C. Pressing-tool for the spinning of metal and alloys. 307,034.

9,256. Kupka, J. Locomotive steam engines. 327,002.

9,716. Dietrich, E. Machines for perforating, cutting, or stamping metal or other sheets. 327,010.

9,884. Reuleaux, O. Aluminium alloys. 309,586.

34,929. Harden, J. Electric induction smelting furnaces. 302,308.

1,201. Allgemzine Elektricitäts-Ges. Furnaces, and especially locomotive furnaces. 304,136.

2,278. Imray, O. Y. (I. G. Farbenindustrie Akt.-Ges.). Process for improving lead. 327,106.

28,313. Summers & Sons, Limited, J., and Freeman, H. B. Galvanising baths. 327,181.

38,496. New Jersey Zinc Company. Zinc base alloys. 305,651.

88. Carborundum Company, Limited (Carborundum Company). Furnaces. 327,390.

1,773. Waygood-Otis, Limited. Bell hoisting mechanism for blast furnaces. 304,772.

2,338. Robertson, H. M. Heat-treating furnaces. 327,486.

2,349. Humphries, C. H. Cadmium plating. 304,668.

10,597. Reitmeister, W. Melting and deoxidising metals and alloys. 327,570.

11,241. Eisen-und Stahlwerk Hoesch Akt.-Ges. Manufacture of metal tyres. 310,325.

12,777. Kauba, F. Method of recovering zinc sulphide from zinc-containing liquids. 327,596.

13,538. Lorkin, W. L., Daglish, E. E., and Swift, H. B. Method for magnetically detecting cracks in steel parts by magnetism. 327,603.

15,082. Taricco, L. Blackening by oxidation of iron and steel. 327,615.

15,848. British Thomson-Houston Company, Limited. Metal-cutting tools. 312,320.

16,691. La Corsa, L. Ughetti-. Electroliser for separation of tin from tin-salt solutions. 313,166.

20,912. Felton & Guilleaume Carlswerk Akt.-Ges. Light metal bobbins for the textile industry. 319,204.

22,217. Vereinigte Stahlwerke Akt.-Ges. Metal sleepers for railways. 317,045.

24,968. Mond, A. L. (I. G. Farbenindustrie Akt.-Ges.). Improving the fatigue strength of metal workpieces. 327,660.

29,602. Harrison, W. R. Roller-spun metal manufacture. 327,667.

Morgan Crucible Company, Limited.

Mr. Justice Maugham, in the Chancery Division Court, has made an order sanctioning a scheme for the reconstruction of the Morgan Crucible Company, Limited, London. The company's present capital is £1,531,600. The scheme provides for the formation of a new company with the same name, but the share capital will be increased to £3,258,000. Holders of deferred ordinary shares in the present company will receive an identical number of fully-paid shares in the new company, except that the shares will be increased to £50 for every £10 now held. It was stated that the company desired to place its capitalisation on a basis which approximated more nearly to the true value of the assets, having regard to their profit-earning capacity. As regarded the shares quoted on the Stock Exchange, the £10 shares were to be converted into pound shares, holders of £10 shares receiving 50 £1 shares for every £10.

His Lordship sanctioned the scheme.

Telephones: SHEFFIELD 22311 (3 lines) LONDON 1483 Central GLASGOW South 1580 WORKSOP 205 AMBERGATE 7 STOCKSBRIDGE 27 GALSTON 49

"SERVICE BCM/GX FIRST."

MANUFACTURERS & PRODUCERS OF REFRACTORY MATERIALS OF EVERY DESCRIPTION
BRICKMAKERS · QUARRY AND MINEOWNERS CONTRACTORS & EXPORTERS.

GENERAL REFRACTORIES LIMITED

Incorporating
THE GENERAL REFRACTORIES CO., LTD. THE MIDLAND REFRACTORIES CO., LTD.
THOMAS BROOKE & SONS LTD. WORKSOP BRICK CO., LTD. GUISELEY SILICA CO. LTD.

Telegrams: "GENEFRAX" Sheffield London Glasgow Worksop
Monomarks: BCM/GX BCM/ Magnesia BCM/ Coroma BCM/ Pyrolyte BCM/ Insulite

KELHAM ISLAND MILLS SHEFFIELD • LOWGROUNDS BRICKWORKS WORKSOP · Notts. • BULLBRIDGE BRICKWORKS AMBERGATE · Derbys • GAYTON ROAD MILLS KINGS LYNN • THE BATTS MILLS WOLSINGHAM · Dur. • BRACKENMOOR FIRECLAY WORKS · STOCKSBRIDGE • LOUDOUN MILLS GALSTON · Ayrshire
AND AT MANSFIELD, WARSOP, EBBERSTON, CORBRIDGE, BRAMCOTE, LUFFENHAM, TOW LAW, MONTGREENAN &c.&c.

LONDON OFFICE 20 Budge Row E.C.4. (M^r A.C. Turner)
Head Office: Wicker Arches, SHEFFIELD
GLASGOW OFFICE 82 Dale St. C.5 (M^r A.W. Montgomery)

"EXTRA STRONG YORKSHIRE SAND"

is highly concentrated and will carry more floor or mixing sand than any other sand in the World.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—For some time past the Cleveland ironmasters, it is understood, have been considering the policy of reducing outputs in view of the steadily diminishing demand for pig-iron, and in conformity with this idea have decided upon a substantial decrease in the number of blast furnaces in active production, thus leaving only 34 in operation on the North-East Coast compared with 46 at the end of October last. Whether this will mark the end of the stoppages remains to be seen. By this means it is hoped to stabilise the position, by checking the accumulation of iron in stock, which of late has been an embarrassment to makers, representing a heavy proportion of owners' capital unprofitably idle. Under these restrictive conditions, however, with the present limited demand no difficulty is anticipated in disposing of any small surplus available for the market. Moreover, stocks of foundry iron are not unduly heavy, and even under the present depressed conditions makers anticipate no difficulty in maintaining prices. On the other hand, it is confessed that business is very slow, and sellers would welcome a more confident note which would encourage the placing of forward contracts. At the moment most of the business is for small lots at the fixed minimum prices, which are: No. 1 Cleveland foundry iron, 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry iron, 66s. 6d.; No. 4 forge, 66s.

Business in the East Coast hematite market is still subject to a limited demand for both home and export transactions, while prices continue irregular with an easier tendency. But since output and consumption are now more closely balanced the more immediate difficulties have been overcome and makers are inclined to resist further pressure. The ruling quotation for mixed numbers in makers' lists is 74s., with the usual 6d. extra for No. 1 quality. On the North-West Coast Bessemer mixed numbers are quoted at 75s. per ton at works.

LANCASHIRE.—In common with other consuming centres, the local demand for foundry pig in the Lancashire area is still below average volume, while buying on forward account is quite exceptional, the majority of buyers being mostly content with satisfying current requirements. Prices remain stationary, with No. 3 Staffordshire and Derbyshire quoted at 77s. per ton and Scottish makes at 95s., all delivered local stations.

THE MIDLANDS.—Consumers of foundry iron in the Black Country districts are, in the majority of cases, none too well employed, and demand, consequently, is on restricted lines. Prices are unchanged, quotations ruling at 75s. for Northants No. 3 and 78s. 6d. for Derbyshire and North Staffordshire No. 3, delivered local stations. The Derbyshire furnaces do not appear to have much stock, while, on the other hand, the Northampton makers would be glad to see an expansion of trade, as in some cases their stocks are heavy and are still accumulating.

SCOTLAND.—There is no change in the prices of pig-iron, No. 3 Scotch foundry remaining at 78s., f.o.t. furnaces. The demand continues very poor and stocks are increasing, but in spite of this the makers hold out no hope of a reduction in price. The Falkirk founders are, however, using very little iron, as they are all on short time, due to the falling-off in building schemes.

Finished Iron.

In this section of the trade the usual quiet conditions still prevail, with a scarcity of business in connection with crown and nut and bolt bars, in which there is a considerable amount of competition from works both in this area and outside for the available tonnage. Crown bars are quoted at £10 to £10 7s. 6d., and nut and bolt bars at £9 per ton and upwards. Staffordshire marked bars are unchanged at £12 10s., and the makers of these continue to be moderately occupied. There is a fair amount of business going abroad to the Belgian and French works for their No. 3 iron. This is being offered quite freely at £5 19s. to £6 1s. delivered in the Darlaston district. From this it will be seen that local iron makers can hope for little support for this grade of iron.

Steel.

Conditions in the semi-finished steel market are not bright, but it is a satisfactory feature of the situation that the British steel makers continue to secure a fair share of the business passing. At Sheffield, there is sharper competition from the Continent. Siemens acid billet sales are smaller, and although there is a moderately active demand for basic billets it shows a sharp falling away when compared with a month ago. Wire rods are having to meet keen Continental competition. Market prices have not varied, but there is some undercutting. A number of open-hearth furnaces in the Sheffield area are being put out of commission in view of the slackness of business. The slump is most noticeable in the cheaper steels, but makers of the more expensive descriptions report a distinct easing off, overseas business being particularly poor. In the tinplate market prices remain steady at 18s. 3d. to 18s. 6d. basis for coke quality, net cash, f.o.b. South Wales ports.

Scrap.

Dealings all round in all descriptions of foundry scrap materials continue on a very limited scale, with prices mostly inclining to still lower levels. On the North-East Coast, however, ordinary heavy cast iron keeps fairly steady at 59s., with machinery quality quoted at 62s. In the Midlands, cast-iron scrap is better than any other quality, 65s. to 67s. 6d. being quoted for machinery cast-iron scrap in cupola sizes and 62s. 6d. for medium material. In Scotland there is no improvement in the cast-iron scrap market, and machinery cast iron suitable for foundries is still quoted at 67s. 6d. to 68s. 6d., ordinary heavy cast iron 62s. 6d. to 63s. 6d., and light cast-iron scrap 54s. to 55s., with firebars at 52s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Following the recent upheaval in values of warrant copper, the market steadied down to an appreciable extent, but quotations subsequently again declined and a lower range of figures is now current. Heavy sales were, however, reported when the market touched bottom, the lower quotations having stimulated a general substantial demand from European consumers, and it is reported that orders have been placed for a few months ahead.

Closing quotations :—

Cash.—Thursday, £55 5s. to £55 10s.; Friday, £54 7s. 6d. to £54 10s., Monday, £53 17s. 6d. to £54 2s. 6d.; Tuesday, £53 17s. 6d. to £54; Wednesday, £55 to £55 5s.

Three Months.—Thursday, £55 to £55 2s. 6d.; Friday, £54 5s. to £54 7s. 6d.; Monday, £53 15s. to £53 17s. 6d.; Tuesday, £53 15s. to £53 17s. 6d.; Wednesday, £54 7s. 6d. to £55 2s. 6d.

Tin.—Although closing at the week-end with a slight improvement, the market for standard cash tin remains somewhat unsettled, being faced with a much larger accumulation than had been anticipated when the detailed forecast of the restricted output was published by the Tin Producers' Association. This is probably the chief factor to be considered when the present situation is reviewed, although at the same time the uncertainty of American consumption must not be forgotten.

Official closing prices :—

Cash.—Thursday, £147 10s. to £147 15s.; Friday, £144 12s. 6d. to £144 17s. 6d.; Monday, £143 10s. to £143 15s.; Tuesday, £141 15s. to £141 17s. 6d.; Wednesday, £143 15s. to £144.

Three Months.—Thursday, £149 5s. to £149 10s.; Friday, £146 15s. to £146 17s. 6d.; Monday, £145 10s. to £145 15s.; Tuesday, £143 12s. 6d. to £143 15s.; Wednesday, £145 12s. 6d. to £145 17s. 6d.

Spelter.—The fact that the price of zinc was so low at the beginning of last week attracted considerable support to the market, but supplies are ample, and at the moment it cannot be said that there are signs of a recovery in the position.

Daily fluctuations :—

Ordinary.—Thursday, £16 7s. 6d.; Friday, £16 7s. 6d.; Monday, £16 7s. 6d.; Tuesday, £16 7s. 6d.; Wednesday, £16 15s.

Lead.—Although still quoted at comparatively low figures, soft foreign pig has recovered to a slight extent, while the market outlook is regarded as more hopeful than other of the non-ferrous metals.

The week's prices have been :—

Soft foreign (prompt).—Thursday, £17 17s. 6d.; Friday, £17 15s.; Monday, £17 16s. 3d.; Tuesday, £17 13s. 9d.; Weduesday, £17 16s. 3d.

Company Meetings.

Johnson & Phillips, Limited.—The annual meeting of Messrs. Johnson & Phillips, Limited, was held recently in London. Mr. John Macgregor (chairman and managing director), who presided, said that they had in hand a record volume of business. Although trade depression seemed most persistent in many branches of British industry, the electrical industry in this country continued its upward movement. During the year they again carried out a large amount of railway electrification work and they looked forward to very considerable expansion in this direction.

Robert Stephenson & Company, Limited.—Sir W. B. Peat, the chairman, presiding at the annual meeting of Messrs. Robert Stephenson & Company, Limited, Darlington, said that they completed 25 engines in 1929, against 40 in 1928. Whilst, however, they had fewer locomotives, they had more boilers last year, increasing their output from eight in 1928 to 33 in 1929. The directors had determined to go in for a larger programme of engine building and to supply themselves with work to get full employment without necessitating a night-shift; full employment meant 60 engines per year.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 52 & 53. MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

Special CARBON BLACKING

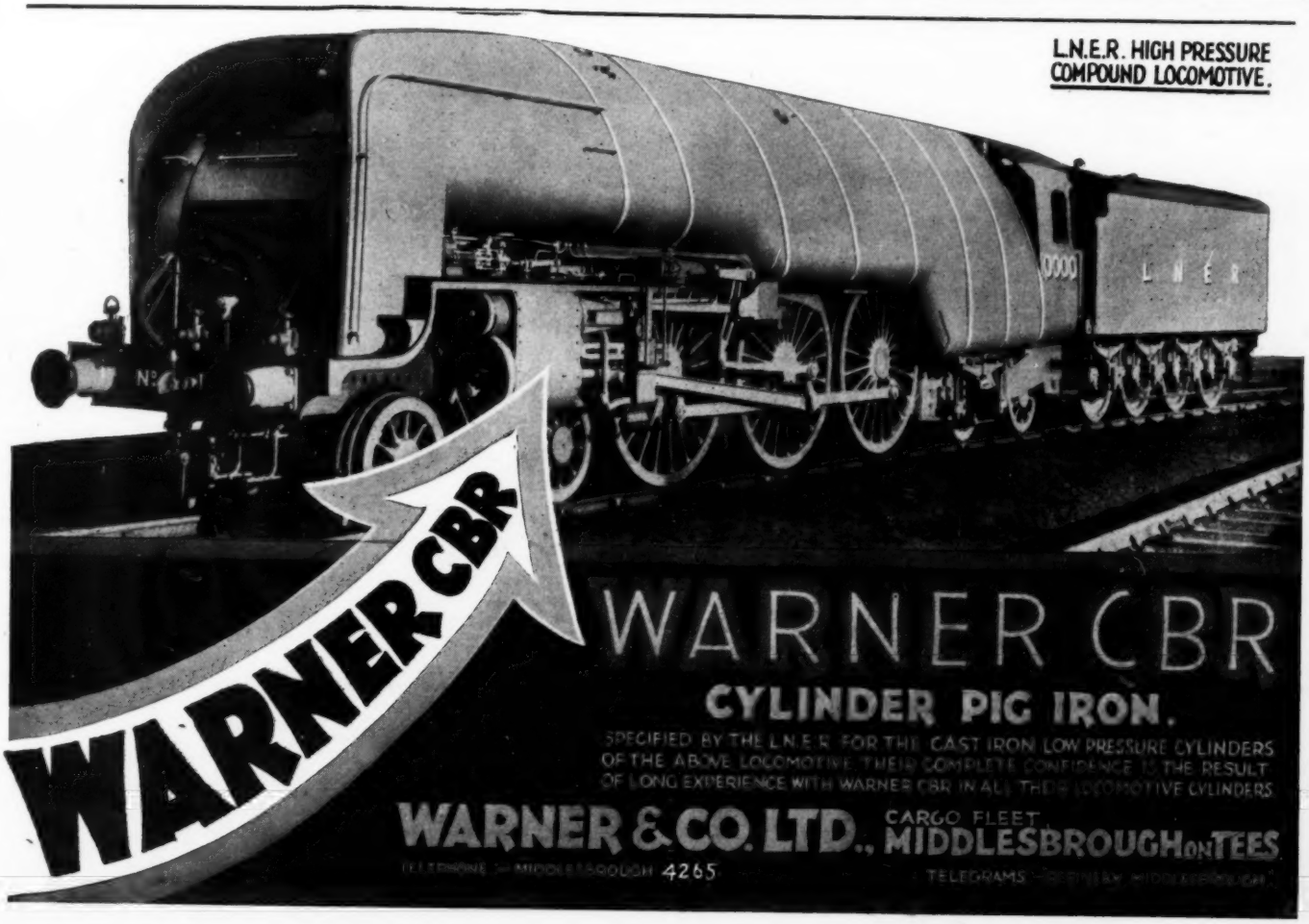
PLUMBAGO
CORE GUM
WHITE DUST
COAL DUST
REQUISITES

67 MADE BY A FIRM WITH YEARS EXPERIENCE.

JAS. DURRANS & SONS. LIMITED.
PHŒNIX WORKS PENISTONE. NR. SHEFFIELD.

Also—
GANISTER, LOAM AND SAND MILLS.
STUDS, CHAPLETS, BRUSHES, CORE ROPES, BUCKETS, SPADES, ETC. LADLES, FIRE BRICKS, STONE FLUX, CASTING CLEANERS, PIPE NAILS, SPRIGS, WIRE BRUSHES, BELLOWS.

L.N.E.R. HIGH PRESSURE COMPOUND LOCOMOTIVE.



WARNER CBR

WARNER CBR
CYLINDER PIG IRON.
SPECIFIED BY THE L.N.E.R. FOR THE CAST IRON LOW PRESSURE CYLINDERS OF THE ABOVE LOCOMOTIVE. THEIR COMPLETE CONFIDENCE IS THE RESULT OF LONG EXPERIENCE WITH WARNER CBR IN ALL THEIR LOCOMOTIVE CYLINDERS

WARNER & CO. LTD., CARGO FLEET, MIDDLESBROUGH ON TEES
TELEPHONE: MIDDLESBROUGH 4265 TELEGRAMS: [illegible]

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	55	0	0
Three months	54	17	6
Electrolytic	60	10	0
Tough	59	10	0
Best selected	60	0	0
Sheets	87	0	0
India	71	0	0
Wire bars	61	7	6
Do. June	61	7	6
Do. July	61	7	6
Ingot bars	61	7	6
H.C. wire rods	63	12	6
Off. av. cash, April	62	3	3¾
Do., 3 mths., April	61	4	10¼
Do., Sttlmnt., April	62	3	7½
Do., Electro, April	75	1	0
Do., B.S., April	68	10	3½
Do., wire bars, April	75	15	3
Aver. spot price, copper, Apr.	62	3	3¾

Solid drawn tubes .. .. 12½d.
Brazed tubes .. .. .. 12½d.
Wire .. .. 8½d.

BRASS.

Solid drawn tubes .. .. 11d.
Brazed tubes .. .. .. 12¾d.
Rods, drawn .. .. .. 10½d.
Rods, extd. or rlld. .. .. 6¾d.
Sheets to 10 w.g. .. .. .. 9½d.
Wire .. .. 9½d.
Rolled metal .. .. .. 8¾d.
Yellow metal rods .. .. 6½d.
Do. 4 × 4 Squares .. .. 7½d.
Do. 4 × 3 Sheets .. .. 7¾d.

TIN.

	£	s.	d.
Standard cash	143	15	0
Three months	145	12	6
English	144	15	0
Bars	146	15	0
Straits	145	15	0
Australian	144	15	0
Eastern	148	5	0
Banca	147	15	0
Off. av. cash, April	162	14	7½
Do., 3 mths, April	164	15	2½
Do., Sttlmt., April	162	14	9
Aver. spot, April	162	14	7½

SPELTER.

	£	s.	d.
Ordinary	16	15	0
Remelted	15	15	0
Hard	14	0	0
Electro 99.9	18	15	0
English	16	17	6
India	15	5	0
Zinc dust	23	0	0
Zinc ashes	4	10	0
Off. aver., April	18	1	11½
Aver., spot, April	17	16	4½

LEAD.

	£	s.	d.
Soft foreign ppt.	17	16	3
English	19	7	6
Off. average, April	18	6	9¾
Average spot, April	18	6	4½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	27	0	0
Do. V.M. ex-whf.	26	0	0
Rods	30	0	0
Boiler plates	24	0	0
Battery plates	24	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	40	0	0
Chinese	27	10	0
Crude	20	0	0

QUICKSILVER.

Quicksilver 22 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	17	6
45/50%	11	10	0
75%	18	5	0

Ferro-vanadium—
35/50% .. .. 12/9 lb. Va.
Ferro-molybdenum—
70/75% c. free .. 4/2 lb. Mo.
Ferro-titanium—
23/25% carbon-free .. 9d. lb.
Ferro-phosphorus, 20/25% .. £16 0 0
Ferro-tungsten—
80/85% .. .. .. 2/10 lb.
Tungsten metal powder—
98/99% .. .. .. 3/1 lb.
Ferro-chrome—
2/4% car. £30 7 6
4/6% car. £23 10 0
6/8% car. £22 12 6
8/10% car. £22 0 0
Ferro-chrome—
Max. 2% car. £33 10 0
Max. 1% car. £37 17 6
Max. 0.70% car. £39 15 0
70%, carbon-free .. .. 10½d. lb.
Nickel—99% cubes, or pellets £175 0 0
Ferro-cobalt .. .. .. 9/6 lb.
Aluminium 98/99% £95 0 0
Metallic chromium—
96/98% .. .. .. 2/7 lb.
Ferro-manganese (net)—
76/80% loose £11 15 0
76/80% packed £12 15 0
76/80%, export £11 10 0
Metallic manganese—
94/96%, carbonless .. 1/4 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten £0 2 2
Finished bars, 18% tungsten £0 3 0
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares, 3 in. and over .. .. 4d. lb.
Rounds and squares, under ½ in. to ¼ in. .. .. 3d. lb.
Do., under ¼ in. to $\frac{1}{16}$ in... 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. .. .. 3d. lb.
Do., under ½ in. × ¼ in. .. 1/- lb.
Bevels of approved sizes and sections .. .. 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	3	0	0	to	3	1	0
Bundled steel and shrngs. ..	2	15	0	to	2	19	0
Mixed iron and steel ..	2	15	0	to	2	16	6
Heavy cast iron	2	17	0	to	2	18	0
Good machinery for foundries..	2	17	6	to	3	0	0
Cleveland—							
Heavy steel					2	12	6
Steel turnings					2	8	0
Cast-iron borings					2	2	6
Heavy forge					3	10	0
W.I. piling scrap					3	7	6
Cast-iron scrap	2	19	0	to	3	2	0
Midlands—							
Ord. cast-iron scrap ..					3	2	6
Heavy wrought	3	7	6	to	3	10	0
Steel turnings	1	12	6	to	1	15	0
Scotland—							
Heavy steel					2	18	0
Cast-iron borings					2	8	6
Wrought-iron piling ..					3	18	0
Heavy machinery					3	8	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	48	0	0
Brass	36	0	0
Lead (less usual draft) ..	16	10	0
Tea lead	12	10	0
Zinc..	9	0	0
New aluminium cuttings ..	62	0	0
Braziery copper	45	0	0
Gunmetal	45	0	0
Hollow pewter	110	0	0
Shaped black pewter	82	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—
Foundry No. 1 .. .. 70/-
Foundry No. 3 .. .. 67/6
Foundry No. 4 .. .. 66/6
Forge No. 4 .. .. 66/-
Hematite No. 1 .. .. 74/6
Hematite M/Nos. 74/-

N.W. Coast—
Hem. M/Nos. d/d Glas. .. 85/6
„ d/d Birm. 93/6

Midlands—
Staffs. common* .. .. —
„ No. 4 forge* .. 73/6
„ No. 3 fdry.* .. 78/6
Shrops. basic .. .. —
„ Cold blast, ord. .. —
„ „ roll iron .. —
Northants forge* 70/-
„ fdry. No. 3* .. 75/-
Derbyshire forge* 73/6
„ fdry. No. 3* .. 78/6
„ basic* .. .. —
*d/d Black Country dist.

Scotland—
Foundry No. 1 .. .. 80/6
„ No. 3 .. .. 78/-
Hem. M/Nos. 81/-

Sheffield (d/d district)—
Derby forge 67/6
„ fdry. No. 3 .. .. 72/6
Lincs. forge. 70/-
„ fdry No. 3 .. .. 75/-
E.C. hematite 89/-
W.C. hematite 90/-

Lincs. (at furnaces)—
Forge No. 4 .. .. —
Foundry No. 3 .. .. —
Basic .. .. .. —

Lancashire (d/d eq. Man.)—
Derby forge 72/-
„ fdry. No. 3 .. .. 77/-
Staffs foundry No. 3 .. 77/-
Dalzell, No. 3 (special) 105/- to 107/6
Summerlee, No. 3 .. .. 95/-
Glengarnock, No. 3 .. —
Gartsherrie, No. 3.. .. 95/-
Monkland, No. 3 .. .. 95/-
Shotts, No. 3 .. .. 95/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)					10	15	0
Nut and bolt iron	9	0	0	to	9	7	6
Hoops					10	15	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip					10	15	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	17	6	to	10	10	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					8	2	6
					and upwards		
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy					8	10	0
Fishplates					12	0	0
Hoops (Staffs)	9	5	0	to	9	15	0
Black sheets, 24 g... ..					9	15	0
Galv.cor.shts., 24g. ..					11	17	6
Galv. fenang wire, 8g. plain					12	0	0
Billets, soft..	6	0	0	to	6	10	0
Billets, hard	7	10	0	to	8	0	0
Sheet bars ..	5	15	0	to	6	5	0
Tin bars ..	6	2	6	to	6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/1½
Sheet to 10 w.g.	1/2
Wire	1/3½
Rods	1/2½
Tubes	1/6¾
Castings	1/1½

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising ..	9d. to 1/3
Rolled—	
To 9 in. wide ..	1/3 to 1/9
To 12 in. wide ..	1/3½ to 1/9½
To 15 in. wide ..	1/3½ to 1/9½
To 18 in. wide ..	1/4 to 1/10
To 21 in. wide ..	1/4½ to 1/10½
To 25 in. wide ..	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.00
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	33.00
Sheet bars	33.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.75
Tank plates	1.75
Beams, etc.	1.75
Skelp, grooved steel	1.80
Skelp, sheared steel	1.80
Steel hoops	2.20
Sheets, black, No. 24	2.55
Sheets, galv., No. 24	3.30
Sheets, blue an'l'd, No. 13 ..	2.15
Wire nails..	2.15
Plain wire..	2.30
Barbed wire, galv.	2.80
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry 27/6
„ furnace .. .. 17/6 to 22/6
Durham and Northumberland—
„ foundry.. .. .. 15/6
„ furnace 15/6
Midlands, foundry .. —
„ furnace .. —

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes ..	20×14 box	..	18/4½
„ ..	28×20 „	..	36/9
„ ..	20×10 „	..	26/4½
„ ..	18¾×14 „	..	19/1½
C.W. ..	20×14 „	..	16/6
„ ..	28×20 „	..	33/9
„ ..	20×10 „	..	23/6
„ ..	18¾×14 „	..	17/-
Terneplates..	28×20	..	32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-Iron ..	£6	0	0	to	£7	10	0
Bars, hammered, basis ..	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis ..	£15	17	6	to	£16	15	0
Blooms ..	£10	0	0	to	£12	0	0
Keg steel ..	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
May	15 ..	55	5	0	dec.	20/–
,,	16 ..	54	7	6	,,	17/6
,,	19 ..	53	17	6	,,	10/–
,,	20 ..	53	17	6	No	change
,,	21 ..	55	0	0	inc.	22/6

Electrolytic Copper.

		£	s.	d.		
May	15 ..	60	0	0	No	change
,,	16 ..	60	0	0	,,	,,
,,	19 ..	60	0	0	,,	,,
,,	20 ..	60	10	0	inc.	10/–
,,	21 ..	60	10	0	No	change

Standard Tin (cash).

		£	s.	d.		
May	15 ..	147	10	0	dec.	32/6
,,	16 ..	144	12	6	,,	57/6
,,	19 ..	143	10	0	,,	22/6
,,	20 ..	141	15	0	,,	35/–
,,	21 ..	143	15	0	inc.	40/–

Tin (English ingots).

		£	s.	d.		
May	15 ..	148	10	0	dec.	35/–
,,	16 ..	145	15	0	,,	55/–
,,	19 ..	144	10	0	,,	25/–
,,	20 ..	142	15	0	,,	35/–
,,	21 ..	144	15	0	inc.	40/–

Zinc Sheets (English).

		£	s.	d.		
May	15 ..	27	0	0	No	change
,,	16 ..	27	0	0	,,	,,
,,	19 ..	27	0	0	,,	,,
,,	20 ..	27	0	0	,,	,,
,,	21 ..	27	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
May	15 ..	16	7	6	dec.	2/6
,,	16 ..	16	7	6	No	change
,,	19 ..	16	7	6	,,	,,
,,	20 ..	16	7	6	,,	,,
,,	21 ..	16	15	0	inc.	7/6

Lead (English).

		£	s.	d.		
May	15 ..	19	10	0	dec.	5/–
,,	16 ..	19	10	0	No	change
,,	19 ..	19	10	0	,,	,,
,,	20 ..	19	5	0	dec.	5/–
,,	21 ..	19	7	6	inc.	2/6

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 6	0 13 3	0 13 3	0 13 3	0 12 5½
1896	0 13 0	0 13 0	0 13 6	0 13 6	0 13 6	0 13 9	0 13 6	0 13 3	0 13 3	0 13 3	0 13 6	0 13 6	0 13 4½
1897	0 13 6	0 13 6	0 13 6	0 13 3	0 13 3	0 13 6	0 13 6	0 13 6	0 13 3	0 13 3	0 13 0	0 13 6	0 13 4½
1898	0 13 6	0 13 6	0 15 0	0 13 6	0 13	0 14 0	0 14 3	0 14 3	0 14 6	0 14 9	0 15 0	0 15 6	0 14 3½
1899	0 15 6	0 15 6	0 16 0	0 16 3	1 0 0	1 1 0	1 1 6	1 1 6	1 1 6	1 1 0	1 2 0	1 5 0	0 19 8½
1900	1 5 0	1 5 6	1 6 6	1 8 0	1 8 6	1 9 0	1 9 0	1 8 0	1 8 0	1 7 0	1 3 0	0 19 0	1 6 4½
1901	0 17 6	0 14 0	0 13 0	0 14 0	0 14 6	0 15 0	0 15 3	0 15 3	0 15 9	0 16 6	0 16 9	0 16 9	0 16 4½
1902	0 16 9	0 15 0	0 15 0	0 15 0	0 15 0	0 15 3	0 15 3	0 15 3	0 15 6	0 16 0	0 16 6	0 16 0	0 15 5
1903	0 15 9	0 16 0	0 16 3	0 16 9	0 16 6	0 16 3	0 16 0	0 15 9	0 15 6	0 15· 0	0 14 6	0 14 0	0 15 8½
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 0½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 6	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 16 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½ (5 months)
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	Strike	Strike	Strike	Strike	Strike	Strike	Strike	1 5 0	1 1 1½
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 9
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

LUMPS

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

XUM

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATION VACANT.

MANAGER wanted for Foundry making castings and refined pig-iron; must have first-class experience; one having practical knowledge of open-hearth furnace preferred.—Apply, stating age, experience, and salary, together with copy of references, to "FOUNDRY," WM. PORTEOUS & COMPANY, Glasgow.

AGENCY.

IMPORTANT French Foundries, producing special high-class (fire-, acid-, basic-resisting) alloy castings, wish to entrust their sale in Great Britain to British foundry, with a view, eventually, to grant manufacturing licence.—Write to Box 516, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

11 ACRES WORKS SITE.
SHEFFIELD.
145,000 Sq. Ft. of SHOPPING,
Compact and Convenient.
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES
Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.
Apply—
THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

IRON Foundry near Derby to Let or Sell; suitable for brass, iron, or motor works.—LUKE BOOTH, Belper, Derby.

PATENTS AND TRADE MARKS.

THE Proprietors of the Patent No. 226751, for Improvements in or relating to Processes for Incorporating Manganese with Iron, are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

THE proprietors of British Patents, Nos. 279862, dated October 29, 1926, relating to "Power Hammers," and 300870, dated April 5, 1928, relating to "Drop Hammers," are desirous of entering into arrangements by way of licenses or otherwise on reasonable terms for the purpose of exploiting the above Patents, and ensuring their practical working in Great Britain.—All inquiries to be addressed to F. HERON ROGERS, Bridge House, 181, Queen Victoria Street, London, E.C.4.

MACHINERY.

SAND MIXERS. — New and Secondhand Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

ONE "Thwaites" Rapid Cupola, as new, size 4, capacity 3 to 4 tons per hour, casing 3 ft. 6 in. dia., overall height 24 ft. 8 in., drop bottom with receiver at side. Price, with one set of bricks (new), £85.—H. F. BAKER, Liquidator, MOBBS & COMPANY, LIMITED (In Voluntary Liquidation), Lion Foundry, Northampton.

MACHINERY—*Continued.*

THOS. W. WARD, LTD.

7-ft. KITCHEN & WADE Heavy Duty Radial Drill, low base, portable work-table.

7½-in. centres WARD Flat Turret Lathe, on 6-ft. 10-in. bed, all geared, s.p.d., 2½-in. hole through spindle.

RUSHWORTH Seven-roll Plate-Straightening Machine, rolls 7½ in. dia., 4 ft. 9 in. long, arranged for motor-drive, without motor.

100-b.h.p. Horizontal Cold-starting Crude Oil Engine, by RUSTON HORNSBY.

EXCELLENT 2 ft. 6 in. gauge, 4-wheel COUPLED SADDLE TANK STEAM LOCOMOTIVE (Bagnalls), cyls. 7 in. dia. x 12 in. stroke; 150 lbs. w.p.

Two 20-h.p. "SIMPLEX" PETROL LOCOMOTIVES, 2 ft. 0 in. gauge; Dorman engine; wheels about 18 in. dia.; about 3 ft. 6 in. wheelbase.

One good Secondhand BABCOCK & WILCOX WATER-TUBE BOILER of 4,356 ft. of heating surface, re-insurable at a working pressure of 150 lbs. per sq. in., with chain-grate stoker, etc.

VERTICAL COCHRAN BOILER, 11 ft. 9 in. x 5 ft. 3 in., working steam pressure 100 lbs. per sq. in.

FOUNDRY LADLES, various types and sizes.

(ASK FOR "ALBION" MACHINERY CATALOGUE.)

ALBION WORKS, SHEFFIELD.

TENDER.

CITY OF NOTTINGHAM.

THE Passenger Transport Committee is prepared to receive Tenders for the supply and delivery of 300 Tons of Steel Tramway Rails, of British manufacture.

Copies of the Specification and Form of Tender may be obtained on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of One Pound, which will be returned on receipt of a bona-fide Tender.

Sealed Tenders, in the official envelope provided, are to be delivered to the undersigned not later than 6 p.m. on Wednesday, June 11, 1930.

The lowest or any Tender will not necessarily be accepted. Tenders will only be accepted from firms who conform to the conditions of the contract as regard paying the local standard rate of wages, etc.

W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
May 17, 1930.

MISCELLANEOUS.

WANTED, a Dozen Sterling Moulding Boxes, 20 in. square.—R. MURRAY & COMPANY, Newcastle-upon-Tyne.

WAX CORE VENTS Tapers, 1 lb. each, Black and Yellow, best quality; all sizes in stock; latest reduced prices.—WM. OLSEN, LIMITED, Cogan Street, Hull.

19 BARRELS Linseed Oil Foots for Sale; £32 10s. per ton delivered f.o.r. Hull.—Box 524, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

"PURIC" CUPOLA FLUX in Block Form cleanses and desulphurises all cupola mixtures. No increase in cost of mixtures, but actual saving obtained, owing to the production of better metal and owing to less wear on the furnace linings.

Over 600 foundries have testified to the advantage of using "Puric." Send for trial cwt.—Write, BEECROFT & PARTNERS, LIMITED, The Foundry Chemists, Retort Works, Mappin Street, Sheffield.

Foundry Consultants and Advisors. Analyses and Testing carried out at low rates at The Laboratories, St. Peter's Close, Sheffield.

MISCELLANEOUS—*Continued.*

GANISTER, best quality for cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

NON-FERROUS CASTINGS. — Inquiries solicited from the Trade. Prompt attention; first-class products; reasonable prices.—PRECISION CASTINGS, LIMITED, Lincoln Street, Wolverhampton.

FLUORSPAR. — The Ideal Flux for all Foundry and Furnace work; supplied in crude lump, washed gravel or finely ground. Samples and prices from

A. BECK,
MINEOWNER, MATLOCK.

'Phone: 287 SLOUGH

SANDBLAST PLANTS

12′ × 9′ Room Plant, complete with compressor and all equipment **£340**

Large Barrel Plant, suitable for castings up to 20 lb. weight, complete with compressor and all equipment **£180**

Cabinet Plant, complete with vertical compressor and all equipment **£60**

ABOVE ARE IN STOCK, ready for use.

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND. PLEASE SEND FOR LISTS.

BUY FROM ME AND SAVE MONEY

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

LOW MOOR FOUNDRY COKE

STANDARD ANALYSES.

Volatile	0·87	...	1·30
Ash...	6·34	...	8·00
Moisture	0·53	...	1·00
Fixed Carbon ...	92·26	...	89·70
	100·00		100·00
Total Sulphur ...	0·37	...	0·50

APPROXIMATE MAXIMUM COMPRESSIVE STRENGTH 3000 lbs.

PHOSPHORUS under 0·04%

CERTIFIED SUITABLE FOR MALTING.

LOW MOOR CLINKERLESS DOMESTIC COKE BURNS CONTINUOUSLY.

MADE FROM THE ORIGINAL AND BLENDED LOW MOOR COALS.

THE LOW MOOR COKE Co., Ltd.,
Low Moor, BRADFORD.

London :	*Low Moor :*
Telephones: 1992 Victoria	365 Low Moor.
Telegrams & Cables: "Withstood Phone London"	"Low Moor 365."

RYLAND'S DIRECTORY

[2,200 pages 8½" × 5½"].

The standard work of reference covering the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades.

1930 EDITION.

ORDER YOUR COPY NOW.
PRICE 42/- BOUND IN CLOTH.

INDUSTRIAL NEWSPAPERS, Ltd.
49 Wellington St., Strand, London, W.C.2.